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SOUTH AUSTRALIAN MUSEUM

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LITTORAL COPEPODA FROM SOUTH AUSTRALIA (II) CALANOIDA, CYCLOPOIDA, NOTODELPHYOIDA, MONSTRILLOIDA AND CALIGOIDA

BY A. G. NICHOLLS, PH.D., UNIVERSITY OF WESTERN AUSTRALIA

Summary

The first part of this paper appeared in Vol VI, part 4, of this Journal and dealt exclusively with the Harpacticoida. The present contribution deals with the remaining groups, all of which are represented. The text of this paper was completed in December, 1941, but could not be published at the time. Since then no publications on these groups have come to my notice calling for any modification of the present paper.

In the introduction to the first part the distribution of the different samples comprising the collection was set out with relevant data, and a number applied to each sample. These numbers are used here when indicating the occurrence of each species. In addition, a list of the samples and the species found in each is given at the end of this paper.

LITTORAL COPEPODA FROM SOUTH AUSTRALIA
(II) CALANOIDA, CYCLOPOIDA, NOTODELPHYOIDA, MONSTRILLOIDA AND CALIGOIDA

By A. G. NICHOLLS, Ph.D., University of Western Australia.

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The same methods of staining and mounting have again been used and, as was the case when dealing with the Harpacticoids, the drawings have all been made with the aid of a *camera lucida*, and the preparations deposited in the South Australian Museum.

The following abbreviations have been used in the figures:

a.1, first antenna.
a.2, second antenna.
ant., anterior.
a.s., anal segment.
cl., claw.
c.r., caudal rami.
dors., dorsal.
end., endopod.
exp., exopod.
lab., labrum.
lat., lateral.
lt., left.
md., mandible.
md.p., mandible palp.
mx., maxilla.
mxl., maxillule.
mxp., maxilliped.
o.c., oral cone.
par., paragnath.
p.1–5, legs 1–5.
post., posterior.
R., rostrum.
rt., right.
Si., siphon.
Ur., urosome.
vent., ventral.

CALANOIDA.

Family PARACALANIDAE Sars 1902.

Genus Acrocalanus Giesbrecht 1888.

Giesbrecht & Schmeil, 1898, p. 25.

Acrocalanus gracilis Giesbrecht.

Scott, A., 1909, p. 29; Sewell, 1929, p. 79; Farran, 1936, p. 81; Dakin and Colefax, 1940, p. 93.

Occurrence. III, 5 males (0·78 – 0·85 mm.), many females (0·74 mm.).

This widely distributed member of the plankton was taken in Spencer Gulf.

FAMILY PHAENNIDAE Sars 1902.

A single specimen of what appears to be a male of the genus *Pseudophaenna* occurred in one of the collections (III). Without the corresponding female it is difficult to ascertain its systematic position with certainty and the description will therefore be withheld until further material has been obtained.

FAMILY CENTROPAGIDAE Sars 1902.

Genus GLADIOFERENS Henry 1919.

Henry, 1919, p. 31; 1922, p. 559.

The genus contains five species: *pectinatus* (Brady, 1899), from coastal waters of New Zealand; *brevicornis* and *spinosus* Henry (1919) described from freshwater in New South Wales, the former being subsequently recorded and fully illustrated by Dakin and Colefax (1940) from the coastal plankton of that region; *gracilis* Kiefer (1931) from freshwater in New Zealand; and *subsalaria* described by Percival (1937) from New Zealand lakes. The new species described below was taken at Blanche Harbour at the north end of Spencer Gulf.

Brady (1899) described (p. 36) and figured (pl. ix, fig. 24–7) a species, *Centropages pectinatus,* which almost certainly should belong to this genus. Unfortunately the specimens were damaged and so his description is very incomplete, but from the structure of the fourth leg (fig. 24) which bears a large curved spine on the coxal segment, and the fifth leg which has the inner claw on the middle segment of the exopod strongly curved and, in general, shows the reduced armature found in *Gladioferens,* I have little hesitation in assigning Brady's species to this genus. Its occurrence is not inconsistent with this conclusion since it was found in the coastal waters of New Zealand and the genus has been recorded both from that region (two species) and from coastal waters (Dakin and Colefax, 1940, and the present collection).

With regard to the fourth leg of the female in this genus Henry (1919, p. 31) states that *each leg* bears "a long curved sword-like spine on the inner edge" of the basal segment and this statement is repeated in the descriptions of the two species (pp. 33, 34, 37), and is not corrected in her later paper (1922). Dakin and Colefax (1940, p. 91), describing a species identified as *G. brevicornis,* point out that this spine occurs only on the left side, which is in conformity with the condition in the species described subsequently. (It may be noted in passing that specimens collected in 1939 from the Swan River, Western Australia, were indistinguishable from *spinosus* except that the enlarged spine was found on only one of the fourth legs; only females were taken so that it is uncertain whether this was correctly identified as *spinosus*). It is possible that Henry was in error in describing this spine as symmetrical, the alternative being that it is variable, but there is no evidence to support this.

It is doubtful if *subsalaria* is really distinct from *brevicornis,* as identified and figured by Dakin and Colefax; there is a remarkable agreement in detail in the shape and armature of the male second, third and fifth legs and terminal segments of the right first antenna; the female genital segment of *subsalaria* as shown by Percival might well be that of *brevicornis.* The right endopod of the fifth leg of the male of *brevicornis* is described by Henry as one-segmented, but the figure suggests three segments, which further supports the possibility of their being synonymous. The alternative, that Dakin and Colefax are really dealing with *subsalaria* and that this is distinct from *brevicornis,* is improbable but can only be decided by reference to the original material in each case.

It is possible also that *pectinatus* (Brady) is synonymous with *brevicornis* or *subsalaria* (if these are distinct) but Brady described the female only. His figures, however, suggest *brevicornis* (as figured by Dakin and Colefax) a noteworthy feature of similarity being the swollen bases of some of the caudal setae common to both species. If these species are synonymous Brady's name will, of course, have to replace *brevicornis*.

The preparation of a key to the females of this genus is at present not practicable partly because there are no outstanding differences between the species, but chiefly because the form and armature of the body, and in particular the urosome, which would probably be the best characters for differentiating the females, have not been described in every case. The key to the males presents little difficulty, and the fifth legs of these have already been used for that purpose by Henry (1922).

KEY TO THE MALES.

1. Both rami of left fifth leg 3-segmented .. .. .. *spinosus* Henry 1919.
   Both rami of left fifth leg 2-segmented .. .. 2.
   Exopod 2-segmented, endopod 1-segmented .. .. 3.
2. End segment of left second endopod armed with a spur at right angles to axis of segment, and seven setae .. .. *gracilis* Kiefer 1931.
   End segment of left second endopod armed with spur directed towards base of legs, two spines and five setae .. .. *inermis* sp. nov.
3. Right fifth endopod 3-segmented .. .. .. *subsalaria* Percival 1937.
   Right fifth endopod 2-segmented .. *brevicornis* Henry 1919 (Dakin & Colefax 1940).

GLADIOFERENS INERMIS sp. nov.

Occurrence. III, 4 females (3 ovigerous), 1 male.

Female. Length 1·09 mm. The urosome is elongate and slender as in *gracilis* but the third segment is more elongate and the caudal rami more slender than in that species. The outer marginal seta on the caudal ramus is inserted at three-fours of the distance along the margin in *gracilis*, whereas in this species it is nearer the end. The coxal spine on the fourth leg is more slender and of a distinctive shape.

Male. Length 0·98 mm. Body of similar shape to that of the female; the urosome is 5-segmented and the caudal rami are not greatly elongated. The right first antenna is modified for grasping, 18-segmented, and having a small terminal claw. The second legs are asymmetrical, the left endopod having the proximal inner seta of the end segment modified into a stout spur. The basal segment of this endopod has its inner proximal corner extended into a spur-like process directed towards the base of the leg. The third and fourth legs are alike, symmetrical and like those of the female, except that the coxal seta is transformed into a spine on each leg, including the second, and is the same on both legs of each pair. It increases in size progressively from the second to the fourth legs. The fifth legs are asymmetrical; the left exopod is 2-segmented and armed with spines, the endopod is 2-segmented, having the large basal segment imperfectly divided, and the terminal segment is armed with four short spines. The right exopod is 3-segmented; the basal segment has an inner distal rounded process, the middle segment is large and prolonged distal to the insertion of the outer spine: it bears an inner basal process, armed with a few spinules and has its inner margin concave; the terminal segment is short, armed with a large terminal and a small outer spine. The endopod is 2-segmented, more slender than that of the left leg and expanded basally.

The first segment of the urosome bears a small lateral process on the left side; the lateral seta on the caudal ramus is inserted at about two-thirds along its length.

In the structure of the fifth legs the male of this species most closely resembles

that of *gracilis,* both differing conspicuously from the other species in this feature. The middle segment of the right exopod has an almost straight inner margin in Kiefer's species, quite different from the condition in *inermis* and the accessory spine on the end segment of this exopod is minute in *gracilis,* whereas here it is strongly developed. The armature of the end segment of the left endopod also differs in these two species. In the fourth leg the terminal spine on the exopod is relatively more slender and less strongly armed than in *gracilis* and in the

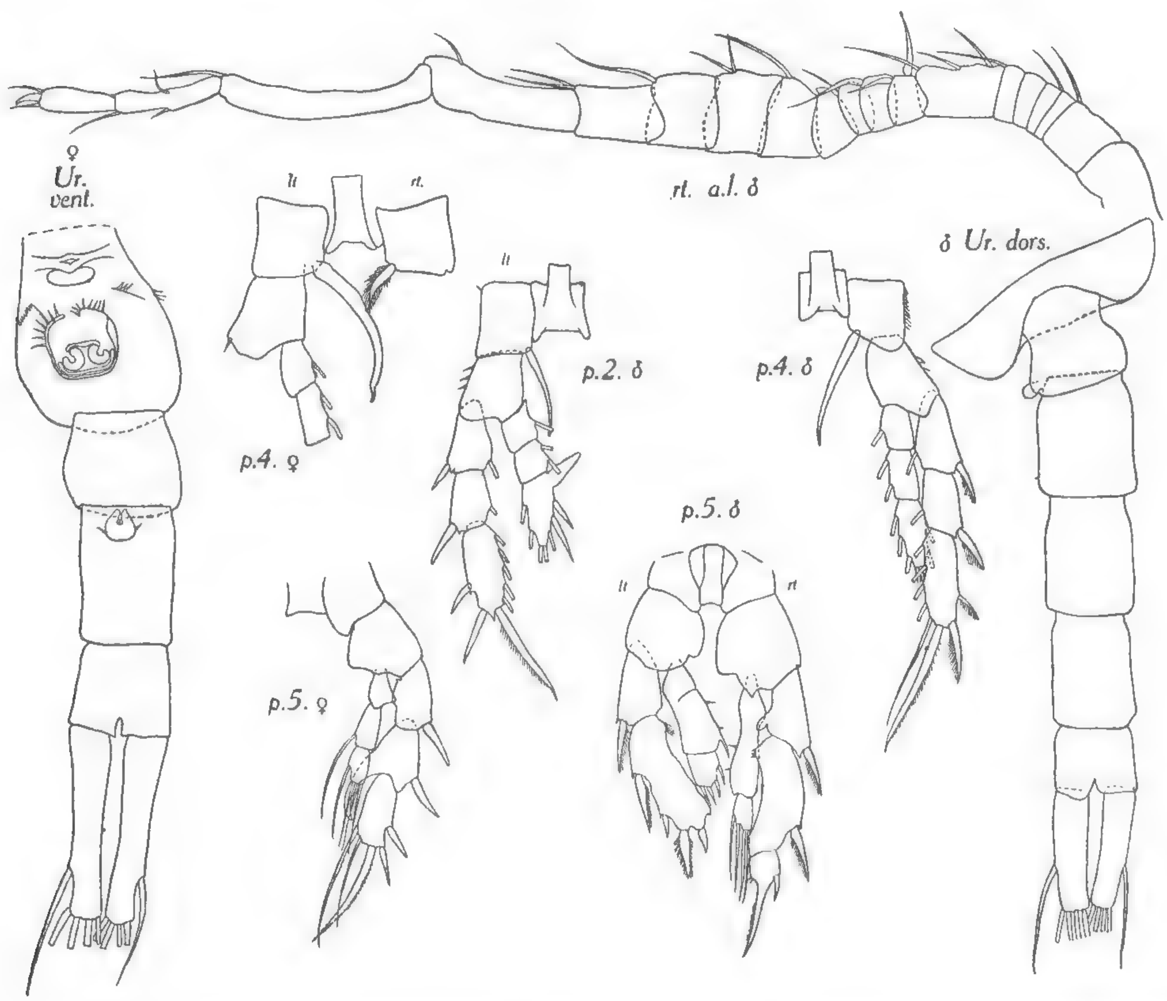

Fig. 1. *Gladioferens inermis* sp. nov., male and female. The male first antenna is drawn from the under surface. All figures × 171.

second legs the spur on the end segment of the left endopod is here more robust than it is in *gracilis,* which differs further in having the two adjacent inner setae unmodified. In *subsalaria* only the first of these setae is transformed into a spine. In the male urosome the asymmetry of the first segment, shown by Kiefer for *gracilis,* is also found here; in both sexes the last thoracic segment and urosome lack the spiny armature found in *gracilis.*

Genus BRUNELLA Smith 1909.

G. W. Smith, 1909, p. 87; Sars, 1912, p. 4.

According to Sars, who has given a full description of this genus, Smith has made a number of errors in his description of the type species, *B. tasmanica.* Thus

Sars asserts that there should be only three segments in the urosome in the female, in conformity with "all other fresh-water Calanoida"; the first antenna of the female should have only 25 segments; the exopod of the first leg should have three segments; and, finally, in Smith's description the right and left fifth legs of the male have been confused. The species found here and described below supports Sars' statements in every respect.

Seven species have been described in this genus(1), keys to both sexes of which are given below. Making allowance for the errors in Smith's description renders it difficult to separate *tasmanica* from *longicornis* Searle, which Sars described in full. He admits the similarity between the two species, and states that *longicornis* "is of smaller size and still more slender form of the body, differing moreover in the greater length of the anterior antennae." The females of these two species and of *steeli* are all very similar, the species being most easily distinguished by their respective males.

The occurrence of the present species from a salt lake appears to be the first occasion on which the genus has been recorded from any but fresh water.

KEY TO THE FEMALES.

1.	Last thoracic segment with rounded postero-lateral corners	2.
	Last thoracic segment with pointed lateral projections, sometimes expanded into wings	5.
2.	Fifth endopod 2-segmented	3.
	Fifth endopod 1-segmented	*ampulla* Searle 1911.
3.	Caudal rami not more than four times as long as wide ..	*steeli* Henry 1924.
	Caudal rami at least five times as long as wide	4.
4.	First antenna extending beyond caudal rami by its last three segments	*longicornis* Searle 1912.
	First antenna scarcely reaching end of caudal rami	*tasmanica* Smith 1909.
5.	Fifth endopod 2-segmented	6.
	Fifth endopod 1-segmented	*salina* sp. nov.
6.	Second segment of fifth exopod with small outer process or spine opposite the large inner claw	7.
	This segment with outer distal corner rounded, unarmed ..	*australis* Searle 1911.
7.	End segment of fifth endopod with 1 inner and 4 sub-terminal setae	*viridis* Searle 1911.
	End segment of fifth endopod with 2 inner, 2 terminal and 2 outer setae	*expansa* Sars 1912.

It has not been deemed advisable to employ the three-segmented first exopod described for *steeli* in the construction of this key, as in the new species described here this exopod is three-segmented, but the segmentation is not very distinct. It is possible that this ramus is subject to variation particularly as the outer spines, which normally indicate the point of segmentation, are absent from this leg.

It is of interest to note that the outer spine is missing also from the proximal segment in all the legs. That the swimming legs are somewhat variable is shown by the variation in armature described for *salina (infra)*.

As far as can be ascertained all the species so far described have been taken from fresh water. This is the first record of a species occurring in a salt lake.

KEY TO THE MALES.

This key is based entirely on the structure of the fifth legs.

1.	Right endopod 3-segmented	2.
	Right endopod 2-segmented	5.
	Right endopod 1-segmented	*ampulla* Searle 1911.

(1) Since this account was written two more species have been described from Western Australia, by W. S. Fairbridge (*Journ. Roy. Soc., West. Aust.*, xxix, in press).

2. Left exopod 3-segmented	*steeli* Henry 1924.
Left exopod 2-segmented	.. .. 3.
3. End segment of left exopod as wide as long	.. .. 4.
End segment of left exopod twice as long as wide	.. *salina* sp. nov.
4. Basal segment of left exopod twice as long as wide	*tasmanica* Smith 1909.
Basal segment of left exopod once and one-half as long as wide ..	*longicornis* Searle 1912.
5. Left endopod 2-segmented	.. .. 6.
Left endopod 1-segmented	*expansa* Sars 1912.
6. Right endopod slender, end segment three times as long as wide, with 4 setae	*australis* Searle 1911.
Right endopod stout, end segment as wide as long, with 8 setae ..	*viridis* Searle 1911.

Searle (1911) has followed Smith (1909) who has apparently confused the right and left fifth legs in the male. The long, curved, terminal claw is on the right leg, as shown by Henry (1924).

BRUNELLA SALINA sp. nov.

Occurrence. VI. Many specimens of both sexes. Of the 100 specimens examined, representing about one-quarter of the total in the collection, 58 were females and 42 males. Some of the females had spermatophores attached but none was found carrying eggs; it is very probable that, as with most of the other members of this family, the eggs are liberated directly into the water. In this respect *Gladioferens* would appear to be an exception.

Female. Length 0·82 – 0·95 mm. The last thoracic segment is expanded into pointed, wing-like processes which are equally developed on both sides. That on the left, however, is somewhat more downturned than that on the right, giving an appearance of asymmetry. The urosome is 3-segmented, the genital segment having a prominent ventral protuberance; the caudal rami are a little more than twice as long as wide and about as long as the two preceding segments together. The first antenna is 25-segmented and reaches to the posterior end of the thorax. The remaining head appendages agree well with Sars' description of *longicornis* except for the mandible palp of which the exopod is relatively longer than in Searle's species, reaching slightly beyond the end of the elongate basis, and is apparently 4-segmented bearing 6 setae. The armature of the swimming legs appears to be subject to variation; the formula given below indicates what appears to be the normal condition, alike in both sexes:

	endopod.	exopod.
p.1.	320.	1.1.321.
p.2.	2.421.	1.1.421.
p.3.	2.421.	1.1.421.
p.4.	2.321.	1.1.421.

The following variations were found: the endopod of one of the first legs in a male had only two inner setae; the exopods of both first legs in a female had only two inner setae on the end segment; the endopod of one of the second legs in a female had only one inner seta on the basal segment; and the exopods of both third legs in a male had only three inner setae on the end segment.

In the armature of the swimming legs considerable differences are shown from the description of *longicornis* given by Sars. In view of the variation found in *salina* however, this may be unimportant.

The fifth legs have a 3-segmented exopod and 1-segmented endopod. The exopod is unarmed except for the inner spur or claw on the second segment, and two unequal spines on the end segment. The endopod shows small constrictions at the point of fusion of the segments, and is unarmed except for two small subequal terminal spines.

Male. Length 0·91 mm. The body differs from that of the female in several important characters. There is a pair of strongly refractive corneal lenses at the front of the head, which are absent from the female, and the last thoracic segment lacks the wing-like processes of the female. This segment has slightly pro-

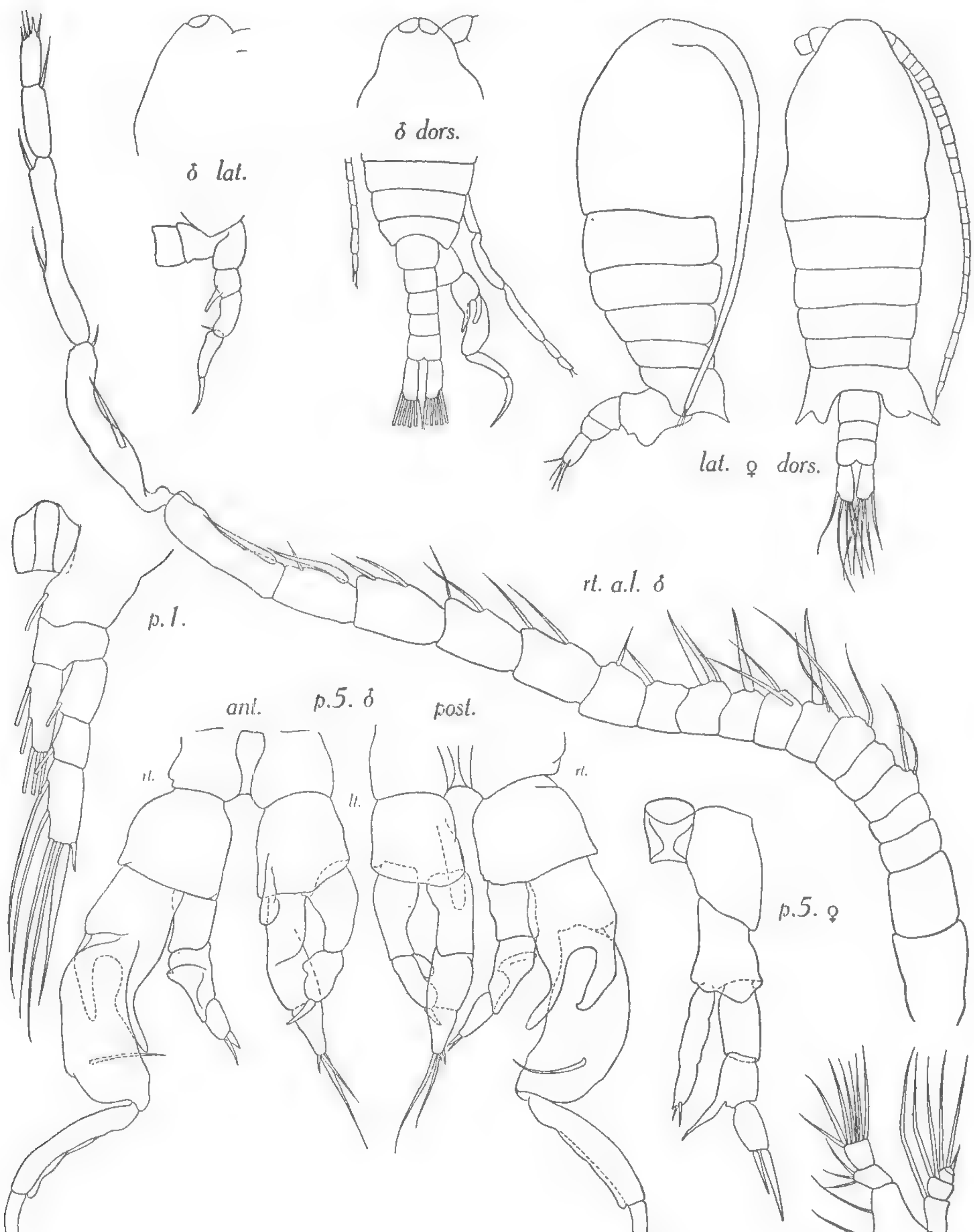

Fig. 2. *Brunella salina* sp. nov., male and female. The male first antenna is drawn from the under surface. Separate appendages × 200; other figures × 67.

jecting posterior corners, which are rounded and unarmed. The right first antenna is considerably longer than the left (which resembles that of the female) extending nearly to the end of the caudal rami, though having only 22 segments.

The complicated fifth leg approaches in its structure most closely to those of *tasmanica* and *longicornis,* but has a much more slender left exopod. The structure of this leg is illustrated from both anterior and posterior surfaces, and its appearance from the right side is also shown. The right exopod is very long, and when extended reaches beyond the caudal rami.

In the female this species is very like *expansa* in its general shape, though the posterior thoracic processes are directed outwards more strongly than in that species and the body is not so slender. The fifth legs in both sexes are quite distinct from Sars' species.

FAMILY PSEUDODIAPTOMIDAE Sars 1902.

Sars, 1902, p. 73.

The family was created by Sars, without definition, for two genera, *Pseudodiaptomus* and *Poppella,* which "together form a natural group somewhat intermediate between the Diaptomidae and the Temoridae." This arrangement was followed by A. Scott (1909) and by Früchtl (1924) but both Sewell (1924, 1932) and Wilson (1932) include *Pseudodiaptomus* in the Diaptomidae.

Genus PSEUDODIAPTOMUS Herrick 1884.

Scott, A., 1909, p. 116; Wilson, 1932, p. 101.

The systematics of this genus, which includes numerous species ranging from purely fresh water to marine conditions, have been discussed by Sewell (1924, p. 784; 1932, p. 233) and by Brehm (1924, p. 84). The latter gives a key which includes most of the species. Sewell (1924) suggested a division of the species into two groups, dependent upon the relative length of the terminal spines on the fifth leg of the female. In one group these spines are sub-equal and comparatively short, while in the second group at least one of these spines is "nearly equal in length to the whole limb".

The species found here comes into the first group and is very close to *salinus* Giesbrecht (1896), which has been recorded from the Mediterranean to the Indian Ocean, but differs in several respects, particularly in the male. The tendency for the species of this genus to have a very localized distribution, particularly where the conditions are less saline, justifies this species in being regarded as distinct from the marine form with its wide distribution.

The salinity at Blanche Harbour, where this form was taken, is presumably lower than that of ordinary sea water, judging by the presence of *Gladioferens* in the same collection.

PSEUDODIAPTOMUS CORNUTUS sp. nov.

Occurrence. III, 16 females (2 ovigerous), 11 males, 5 young.

Female. Length $1 \cdot 20 - 1 \cdot 24$ mm. Body symmetrical, head fused with first segment, the latter bearing a pair of rounded knobs dorso-laterally on the posterior margin. The fourth and fifth segments are fused, and the posterior corners produced into spine-like processes extending beyond the middle of the genital segment. The urosome is 4-segmented, the genital segment being the longest and having a ventral swelling. There is a group of spinules laterally on the left side of this segment. The caudal rami are three times as long as wide. The first

antennae extend to the posterior margin of the genital segment. The fifth legs are very like those of *salinus*, as illustrated by Thompson & Scott (1903, pl. ii, fig. 21) but the basal segment of the 2-segmented exopod (there is no endopod) is more elongate and has the inner distal corner extended into a triangular projection. The outer of the two large terminal spines has the small middle spine fused with it at the base.

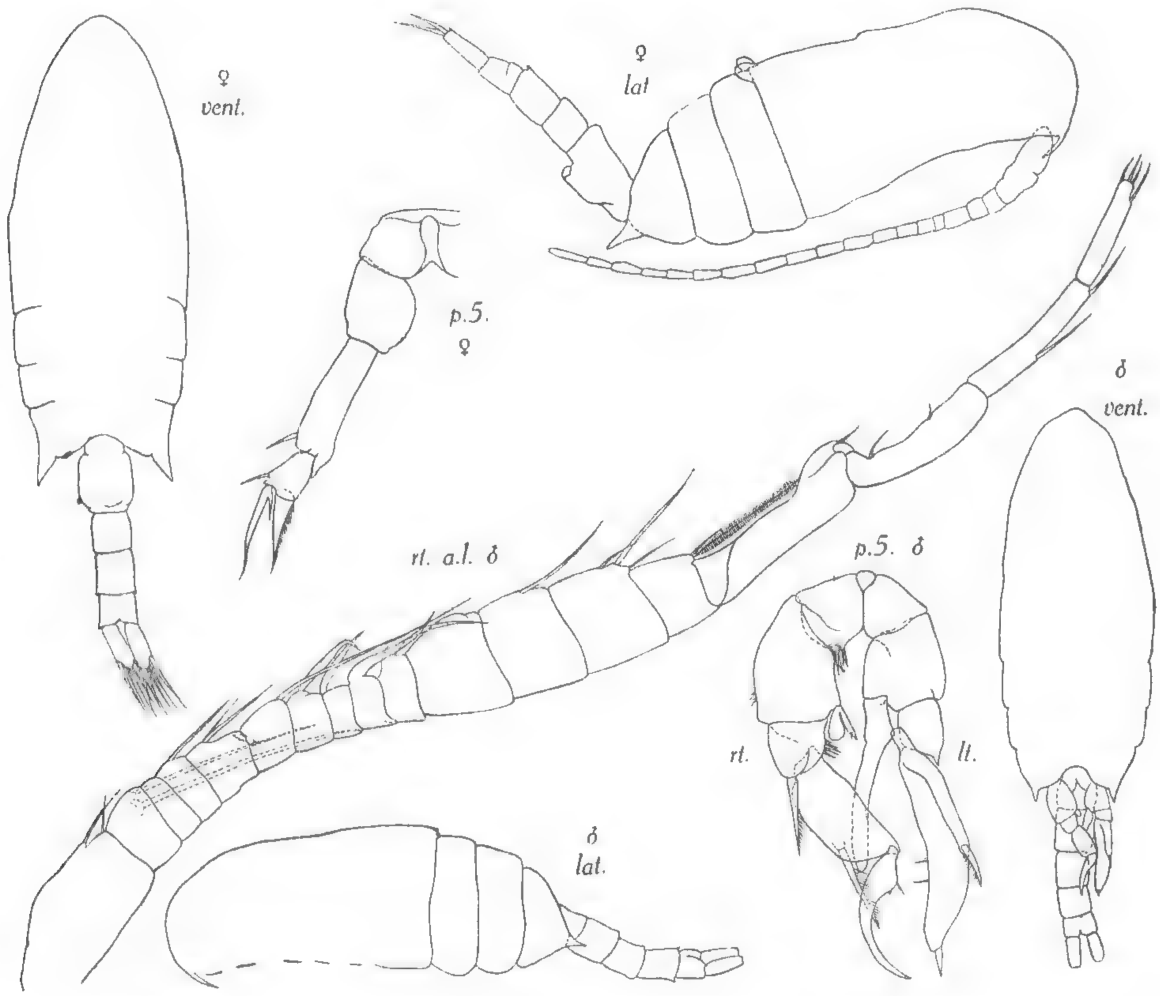

Fig. 3. *Pseudodiaptomus cornutus* sp. nov. Male and female × 57; appendages × 171.

Male. Length 0·93 – 1·04 mm. Body as in the female but the dorso-lateral knobs on the first segment are less pronounced when seen in lateral view than in the female. The urosome is 5-segmented and the caudal rami are similar to those of the female. The right first antenna is composed of 18 segments and reaches to the posterior margin of the second segment of the urosome. The fifth legs in the extended position reach to the middle of the fourth segment of the urosome. These legs show certain differences in proportions and armature from those of *salinus*, as shown by Thompson & Scott (*op. cit.* pl. ii, fig. 22). The coxa of the right leg bears two bifid spines set on small prominences at its inner distal corner, not shown for *salinus*, and the right endopod has the outer lamelliform plate wider than in Giesbrecht's species. The terminal segment of this exopod is here modified into a long curved claw reaching beyond the end of the left leg. The distal segment of the left exopod is more slender than in *salinus* and has a rounded

proximal extension directed towards the base of the leg. The outer spine is inserted at approximately the middle of the margin and the segment is rounded terminally, bearing a short spine.

The male of *salinus*, first described by Thompson and Scott (*loc. cit*) is of the same size as the female. In the species found here the male is distinctly smaller. Both sexes are further distinguished from *salinus* by the knob-like projections on the cephalic segment.

FAMILY PSEUDOCYCLOPIDAE Giesbrecht 1893.

Giesbrecht and Schmeil, 1898, p. 125; Sars, 1902, p. 129.

Genus PSEUDOCYCLOPS Brady 1872.

Giesbrecht and Schmeil, 1898, p. 125; Sars, 1902, p. 130.

Six species have already been described as belonging to this genus, though males are known for only four. The female of a seventh is described and keys for the identification of the species are given below. It is not practicable to include Esterly's (1911) species *magnus* in the key as the description is very brief and the figures very few; unfortunately also, the male is unknown.

Despite the difference in size there is a strong probability that *magnus* (1·1 mm.) and *latens* (0·63 mm.) are identical. The fifth legs of the female are figured in both cases and show a strong resemblance, differing chiefly in the absence in *magnus* of the spinules surrounding the bases of two of the terminal spines of the exopod shown for *latens*.

This leg in these species is quite different from those of other species, being characterized by the partial or apparent fusion between the first and second segments of the endopod, both of which are unarmed, and the second segment being widened and extended into spurs on both sides distally so that the small terminal segment appears to be sunk into a recess. The end segment is produced into a spur at the outer distal corner and bears a small adjacent terminal seta, the inner corner being produced into a very small point. From the two descriptions and figures there is no reason for separating them as species and their occurrence lends further support since it has been shown that the Bermudan fauna is closely related to that of the Suez Canal zone (Willey, 1930, pp. 82, 113). In the event of this synonymy being established Gurney's name will, of course, have to give way to Esterly's.

KEY TO THE FEMALES OF PSEUDOCYCLOPS.

1. Two or more segments of the fifth endopod fused .. .. 2.
   Segmentation of this endopod distinct .. .. 3.
2. Second and third segments of fifth endopod fused, end segment of exopod with 2 inner setae; first antenna 15-segmented .. .. *umbraticus* Giesbrecht 1893.
   All three segments of fifth endopod fused, end segment of exopod with 1 seta and 3 short spinules; first antenna 17-segmented .. .. .. *crassiremis* Brady 1872.
3. Caudal rami much wider than long, overlapping in mid-line .. *latens* Gurney 1927
   Caudal rami at least as long as wide, separated .. .. 4.
4. Fifth endopod with first and second segments produced into sharp processes at the outer distal corners .. .. 5.
   Only the second segment so produced .. .. *obtusatus* Brady and Robertson 1873.
5. Endopod of second antenna 2-segmented; caudal rami longer than wide, parallel; first antenna 17-segmented .. .. *simplex* Sewell 1932.
   Endopod of second antenna 3-segmented; caudal rami no longer than wide, divergent; first antenna 18-segmented .. .. *australis* sp. nov.

KEY TO THE MALES.

1.	Endopod of right fifth leg a rounded or rectangular plate	2.
	This endopod short, tapering to a sharp point	*crassiremis* Brady 1872.
	This endopod elongate, slender, distally curved inwards ..	*simplex* Sewell 1932.
2.	This endopod rounded, unarmed, articulating with the basipod	*umbraticus* Giesbrecht 1893.
	This endopod sub-rectangular, truncate, bearing a short triangular spine on its posterior surface, and completely fused with the basipod ..	*obtusatus* Brady and Robertson 1873.

The details for the species *obtusatus* and *crassiremis* used in these keys were obtained from Sars 1902 and 1921 respectively.

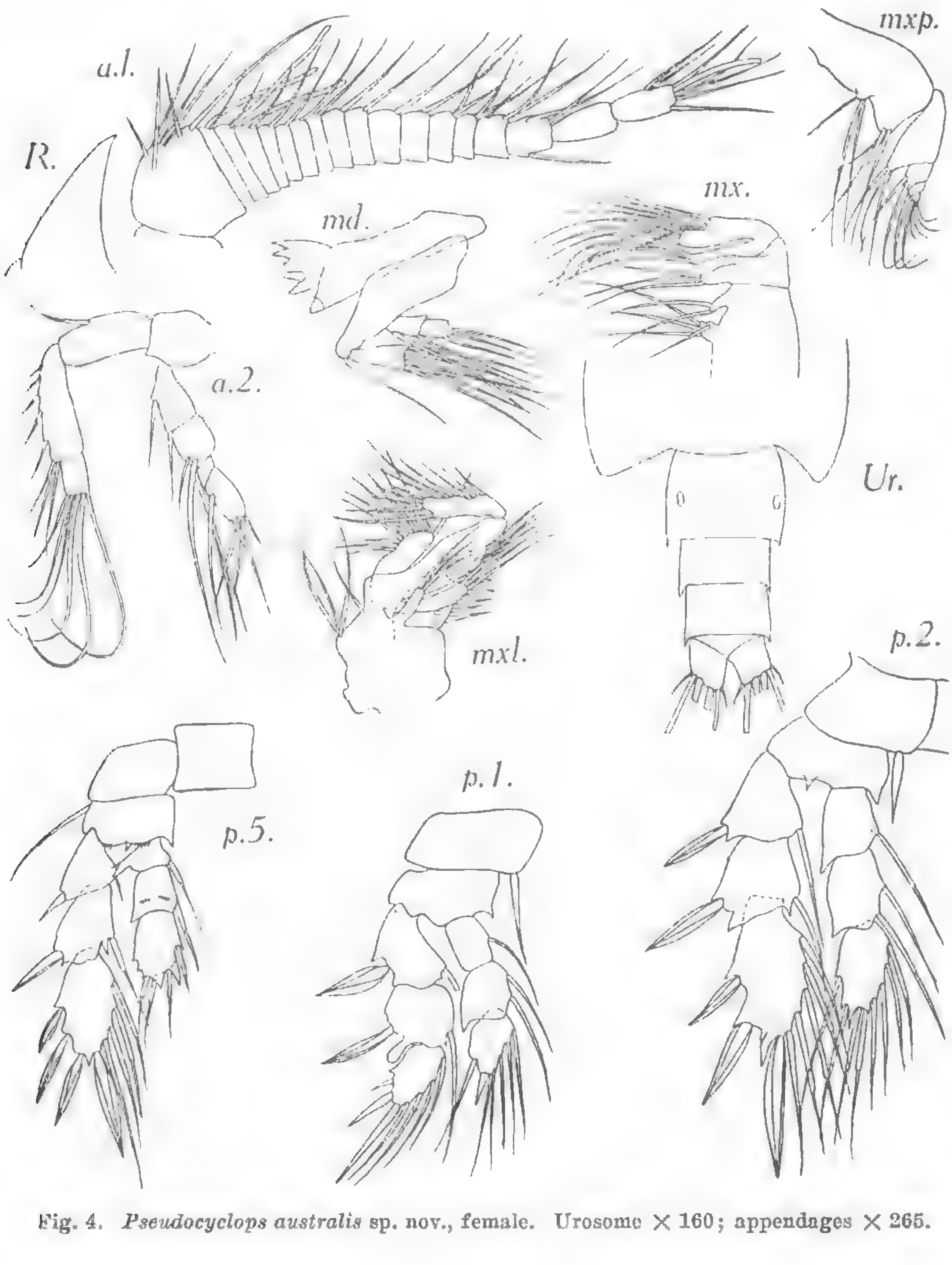

Fig. 4. *Pseudocyclops australis* sp. nov., female. Urosome × 160; appendages × 265.

PSEUDOCYCLOPS AUSTRALIS sp. nov.

Occurrence. XIII, 1 female, 1 juvenile.

Female. Length 0·78 mm. The body is of similar proportions to *obtusatus;* the urosome is 4-segmented, the anal segment being very short and partly telescoped into the pre-anal; the caudal rami are as long as wide, and somewhat divergent. The first antenna has eighteen segments and the second antenna has the end portion distinctly cut off as a separate segment. The mouth parts are much as in *obtusatus.* The middle segment of the endopod of the first leg has an elongate bulbous process distal to the outer spine. In the fifth leg both the first and second segments of the endopod have their outer distal corners produced into processes, that on the first segment being very pronounced and bearing a small seta; the end segment has several distal processes, two of which are large, and bears four setae. The seta formula is as follows:

	endopod.	exopod.
p.1.	1.2.321.	1.1.412.
p.2.	1.2.422.	1.1.512.
p.3.	1.2.422.	1.1.513.
p.4.	1.2.322.	1.1.513.
p.5.	1.1.220.	1.1.413.

The species is not unlike *simplex* but differs in the armature of the swimming legs and in the caudal rami.

FAMILY PONTELLIDAE Giesbrecht 1892.

Giesbrecht and Schmeil, 1898, p. 131; Sars, 1902, p. 137.

Genus CALANOPIA Dana 1852.

Giesbrecht and Schmeil, 1898, p. 131; A. Scott, 1909, p. 175.

CALANOPIA THOMPSONI A. Scott

A. Scott, 1909, p. 178; Sewell, 1932, p. 342.

Occurrence. I, 3 females, 1 male; II, 7 females, 5 males, 2 juveniles; III, 1 female; IV, 8 females, 4 males; V, 2 juveniles ?; VII, 1 female; IX, 1 female; XIV, 2 females, 1 male.

Distribution. Malay Archipelago, Southern Burma, Ceylon Pearl Banks, "Investigator" Stations 587, 614.

With the exception of the "Investigator" collections all of the places where this species has been taken are coastal, usually quite close to the shore, often having been taken while the vessel was at anchor. In the case of the exceptions mentioned I have been unable to trace the localities of these stations, but from the remarks made by Sewell (1929, p. 2) it would appear at least probable that these stations fall into line with the above. The species must, therefore, be regarded as a coastal form and it is interesting to find it in the present collections, which are all taken from the western shores of South Australia. Furthermore, although the genus is represented in the waters of New South Wales (Dakin and Colefax, 1940, p. 105) this species has not been recorded from that region.

Genus LABIDOCERA Lubbock 1853.

Giesbrecht and Schmeil, 1898, p. 132; Sars, 1902, p. 141.

LABIDOCERA CERVI Kramer 1895.

Kramer, 1895, p. 218; Brady, 1899. p. 37; Farran, 1929, p. 275; Dakin and Colefax, 1940, p. 101.

Occurrence. II, 1 female (2·60 mm.); IV, 1 male (2·95 mm.); V, 1 male (2·42 mm.).

Distribution. Coastal waters of northern New Zealand, and of southern and eastern Australia.

In the female found here the abdomen was distinctly three-segmented as pointed out by Dakin and Colefax; the male and female fifth legs agree well with those figures by these authors (fig. 148 d, f).

LABIDOCERA CAUDATA sp. nov.

Occurrence. V, 2 females.

Female. Length 2·24 mm. The head is rounded and without crest or side hooks; the urosome appears to be 2-segmented but is so completely enveloped by the spermatophore that its segmentation is somewhat obscured. The asymmetry

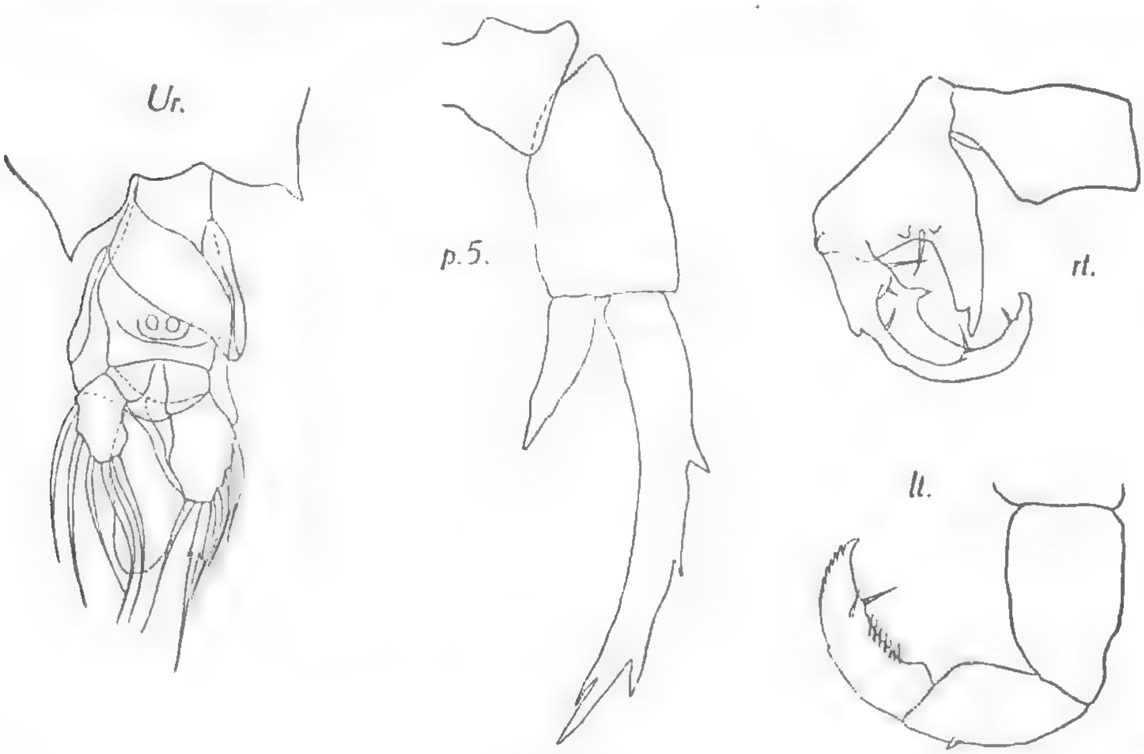

Fig. 5. *Labidocera caudata* sp. nov., female. Urosome × 69; fifth leg × 206. *Tortanus barbatus* (Brady), male fifth legs × 206.

shown by the caudal rami is unusual in that the left ramus is larger than the right; there is no lateral outgrowth on the genital segment, which is slightly swollen ventrally. The fifth thoracic segment ends in lateral points which are also symmetrical. The fifth legs have a comparatively large endopod, reaching as far as the first outer spine of the exopod. The spines on the exopod are none of them very large except the terminal spine which is long and sharply pointed.

This species clearly cannot be identified with that described as sp. (nov.?) by Dakin and Colefax, but approaches most closely to *gangetica* Sewell (1934). I have been unable to compare it with *rotunda* Mori (1929) and *japonica* Mori (1935) as the publication in which the descriptions have appeared is not available in Australia.

FAMILY TORTANIDAE Sars 1902.

Sars, 1902, p. 73.

This family was one of those created by Sars without definition to include the two genera *Tortanus* and *Mormonilla*, but A. Scott (1909) places the latter in a separate family.

Genus TORTANUS Giesbrecht 1898.

Giesbrecht and Schmeil, 1898, p. 157; Steuer, 1926; Sewell, 1923, p. 398.

The latest revision of this genus, by Sewell, divides it into two subgenera, *Tortanus* and *Atortus*.

TORTANUS (TORTANUS) BARBATUS (Brady).

Brady, 1883, p. 71 (*Corynura*); Sewell, 1932, p. 399.

Occurrence. II, 1 female, 1 male; III, 2 females, 1 juvenile; V, 1 female.

Distribution. Indo-pacific and Malayan regions.

This species has been recorded from the coastal waters of New South Wales by Dakin and Colefax (1940) who state (p. 106) that they were unable to discover any description of the male in the available literature. From Steuer's (1926) revision of the genus, to which these authors did not have access, it appears that Früchtl (1924) has described the male. Steuer himself described it from fresh material and, although his figure of the fifth legs is not very clear, the structure of the caudal rami and the smaller size make it almost certain that the male found here is that of Brady's species. At the same time, the fifth legs of the male figured by Dakin and Colefax (*loc. cit.*, p. 104, fig. 161 c) agree closely with those found in this specimen. The caudal rami are also similar and the probability is, therefore, that despite the difference in size of their specimen it should be identified as the male of *barbatus*. Unfortunately in the single male at my disposal the right antenna was broken off close to the base. Früchtl's illustration (fig. 42) of the male fifth legs agrees in structure with that given here (fig. 5) but he does not show the full armature on the left leg.

CYCLOPOIDA.

In attempting the description of the Cyclopoids in this collection I have followed Sars' system of classification. This was completed in 1918, and does not appear to have been modified to any serious extent since that time. Sars divides the group into three Sections according to the structure of the mouth parts. The characteristic features may conveniently be summarized in the form of a key:

1. Second antenna with an exopod (usually); mouth parts suctorial; maxillae and maxillipeds sub-chelate .. .. SIPHONOSTOMA (II).
   Second antenna without an exopod; mouth parts non-suctorial; maxillae never sub-chelate (maxillipeds sometimes in male) .. .. 2.
2. Second antenna non-prehensile; mouth parts masticatory; first antennae hinged in male GNATHOSTOMA (I).
   Second antenna usually prehensile; mouth parts non-masticatory; first antenna in male not hinged .. .. POECILOSTOMA (III).

Apart from two species of *Oithona*, normal constituents of the plankton, no members of Section I were found. It is somewhat surprising that no Cyclopinidae were found, since these are littoral forms, but further search will probably reveal representatives of this family.

GNATHOSTOMA.

FAMILY OITHONIDAE Sars. 1913.

Genus OITHONA Baird 1843.

Sars, 1913, p. 4; Rosendorn, 1917.

OITHONA NANA Giesbrecht 1892.

Sars (1913, p. 5) suggests that this species should constitute the type of a new genus, *Oithonina.* This was not accepted by Rosendorn (1917) but Wilson (1932) uses Sars' generic name for this species. I have followed Rosendorn, who regards *nana* as the type of a group of species within the genus *Oithona.*

Occurrence. III, several females (0·52 - 0·72 mm.).

Distribution. Widely distributed in the warmer regions, also found in the North Sea. The species has not, apparently, previously been recorded from Australian waters.

OITHONA ATTENUATA Farran 1913.

Occurrence. III, several females (0·50 mm.).

Distribution. Chiefly Indo-pacific; recorded also from the Atlantic (Rosendorn). This species has previously been recorded from Australian coastal waters by Farran (1936).

SIPHONOSTOMA.

The bulk of this collection comprises chiefly those copepods peculiarly adapted for a semi-parasitic existence, for which they are provided with suctorial mouth parts. This interesting group has been divided by Sars into a number of families, all but one of which are represented here. Their more important distinguishing characters can again best be summarized in the form of a key:

KEY TO THE FAMILIES.

1. Second antenna non-prehensile .. .. 2.
   Second antenna strongly prehensile .. .. .. CANCERILLIDAE Sars 1915.
2. Fourth legs present .. .. 3.
   Fourth legs absent .. .. ARTOTROGIDAE Sars 1915.
3. Body expanded, with well developed epimera; genital segment widened anteriorly; fifth legs reduced to a knob-like process; fourth endopod usually reduced or absent (in a few cases normal) .. .. DYSPONTIIDAE Sars 1915.
   Body more or less slender, usually without epimera; genital segment only slightly widened anteriorly; fifth legs 2-segmented, though proximal segment not always clearly defined; fourth endopod always well developed .. .. 4.
4. Sensory filament of first antenna on terminal segment; mandible without palp MYZOPONTIIDAE Sars 1915.
   Sensory filament of first antenna sub-terminal; mandible palp present .. .. 5.
5. Second antenna as long as first, its exopod as long as the third segment; siphon reaching at least to genital segment, usually to caudal rami .. ACONTIOPHORIDAE Sars 1915.
   Second antenna much shorter than first, its exopod shorter than the third segment; siphon much shorter, sometimes absent .. ASTEROCHERIDAE Giesbrecht 1899, sens. str.

As will be seen, the Dyspontiidae are somewhat difficult to define as a family, and to separate from the others. Hansen (1923, p. 2) retains Giesbrecht's Asterocheridae in its widest sense and disagrees with Sars' division of that family into smaller families. With the possible exception of the Dyspontiidae it appears that

Sars' families are well defined. In this family, while the typical forms show a first antenna with reduced segmentation and the fourth endopod reduced or absent, in some forms this leg is normal and the first antenna has a greater number of segments and does not show the fusion of segments between the second and eighth so characteristic of the majority of the genera.

These few exceptional genera nevertheless show the expanded body with well-developed epimera and have the female genital segment greatly expanded in its anterior half. These two features are, therefore, regarded as characteristic of the family, and those genera which do not show the reduction in the first antenna and fourth leg, but are otherwise typical, are regarded as intermediate between the Asterocheridae and Dyspontiidae.

FAMILY ASTEROCHERIDAE Giesbrecht sens. str.

syn. Ascomyzontidae Sars, 1915, p. 83.

Sars *(op. cit.*, p. 85) discards Boeck's name *Asterocheres* in favor of Thorell's *Ascomyzon*, although he admits it has priority, because "the species of this genus are by no means exclusively parasites of Asterids". Boeck's name must, however, stand on rules of priority and has been accepted by recent authors.

Thorell (1859) used the name Ascomyzontidae to designate a family which is apparently equivalent to the Asterocheridae of Giesbrecht (1899) since the latter author had previously (1895, 1897) used Thorell's name, and in 1899 (p. 67) place this name as a synonym of his new name.

Giesbrecht divided his family into sub-families, which Sars (1915) raised to family status, and further subdivided, but reverted to the name Ascomyzontidae, used in a restricted sense, equivalent to Giesbrecht's sub-family Asterocherinae from which he removed the genus *Acontiophorus* as the type of a new family.

As stated above, I have followed Sars' classification, but since the genus *Ascomyzon* no longer exists it cannot be used for the family name. I have, therefore, substituted Giesbrecht's Asterocheridae, used in the restricted sense equivalent to Sars' Ascomyzontidae.

One genus of this family was found here and a new genus, which approaches *Dermatomyzon*, is described.

AUSTRALOMYZON gen. nov.

The genus is defined by the following combination of characters: Body comparatively slender, with little or no development of epimeral plates; urosome 4-segmented in the female, 5-segmented in the male; first antenna with the segmentation of the proximal region distinct; second antenna 4-segmented, with a reduced exopod attached to the second segment; oral cone produced into a siphon, reaching to the first legs; rami of the first four pairs of legs 3-segmented.

The genus is intermediate between *Dermatomyzon* and *Rhynchomyzon*, resembling the latter in general appearance, having posterior projections on the metasome segments, and the former in having similar projections on the urosome segments. It resembles both of these genera in the segmentation of the urosome and differs from both in the presence of a well developed siphon.

AUSTRALOMYZON TYPICUS sp. nov.

Occurrence. IX, 1 male; XI, 2 females.

Female. Length 1·20 mm. Anterior body ovoid, rounded in front, with a small rostrum directed postero-ventrally. The first segment is fused with the head, the second and third have postero-lateral projections, and the fourth seg-

ment is very small; the fifth segment is expanded laterally and bears the one-segmented fifth legs. The genital segment is nearly as long as the three posterior segments and not greatly expanded anteriorly. This and the following segment

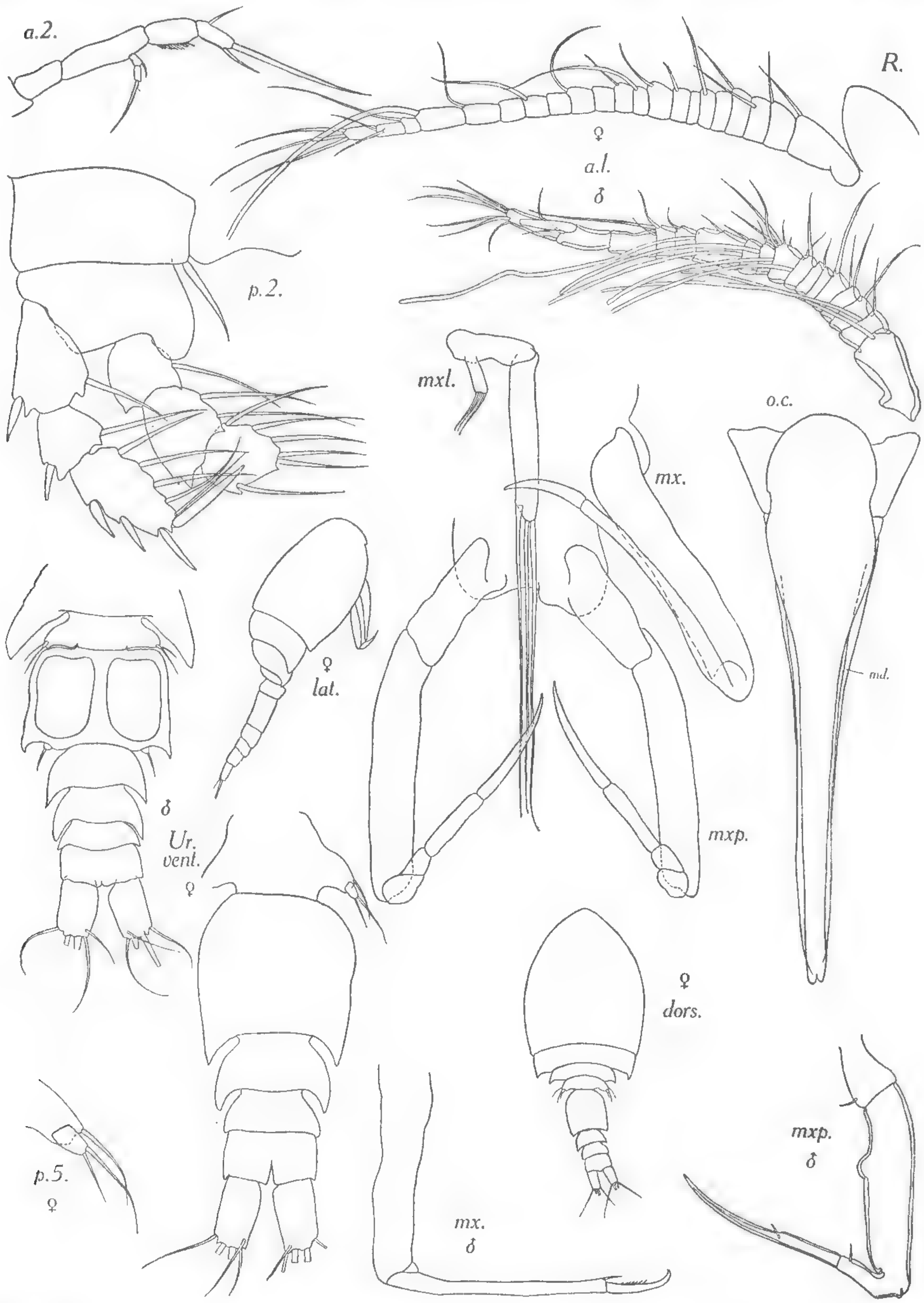

Fig. 6. *Australomyzon typicus* gen. et sp. nov., male and female. Female × 29; urosome, both sexes, × 110; appendages × 183.

have postero-lateral projections, similar to those of the thoracic segments. The caudal rami are about twice as long as wide, and half as long again as the anal segment.

The first antenna is 21-segmented, having the sensory filament on the eighteenth; the second antenna is 4-segmented, with a 2-segmented exopod attached to the outer distal margin of the second segment. The oral cone is wide basally, tapering gradually, stoutly constructed and reaches only to the base of the first legs. The mandible palp is thin and as long as the siphon. The maxillule has a small outer lobe, bearing three short setae, and a long inner lobe also with three setae, which are long. The maxilla and maxilliped are of comparatively slender structure. The swimming legs are strongly built, and all of the same general structure. Seta formula:

	endopod.	exopod.
p.1.	1.2.321.	1.1.323.
p.2.	1.2.321.	1.1.423.
p.3.	1.2.321.	1.1.423.
p.4.	1.2.221.	1.1.423.

Of these, in addition to the outer spines of the exopods, the outer terminal appendage of the exopod in all legs, and the inner terminal appendage of the third and fourth endopods is a spine. There are no spines on the first and second endopods. The fifth legs are one-segmented appendages bearing two terminal setae; the basal segment is fused with the fifth segment and bears one seta. The caudal rami each bear one distal lateral seta, one dorsal and three terminal setae.

Male. Length 1·02 mm. This differs from the female in a few characters. The urosome is 5-segmented; the genital segment is rectangular in shape and this and the three following segments have postero-lateral projections. The anal segment is relatively slightly shorter than that of the female. The first antenna is 17-segmented, the last three segments being fused. In addition to the large subterminal sensory filament there are a few more slender filaments attached one to each of segments 1, 2, 8, 9, 10, 11 and 12. The maxilla and maxilliped are more slender than in the female. The armature of the swimming legs is identical with that of the female; the fifth legs are similar but smaller, and sixth legs are present as small knobs on the posterior margins of the genital segment.

Genus Scottocheres Giesbrecht.

Giesbrecht, 1897, p. 18; Sars, 1915, p. 106.

The genus was established by Giesbrecht for a species wrongly assigned to *Acontiophorus* by T. & A. Scott (1894: *A. elongatus*); at the same time he described a second species, *S. longifurca.* In 1902 he described *S. stylifer;* a fourth species, *S. gracilis,* being subsequently described by Hansen (1923).

Scottocheres latus sp. nov.

Occurrence. IX, 1 female.

Female. Length 0·91 mm. The body is very rounded anteriorly, its width being nearly equal to the length of the head and first free segment together. The urosome is 3-segmented, the genital segment forming half of the total length of the urosome and is slightly expanded anteriorly, without lateral teeth, but has a bunch of setae on each side distal to the centre; the second and third segments are sub-equal. The caudal rami are subrectangular and about half of the anal segment.

The first antenna is 19-segmented, distinctly divided into two regions, the proximal 9-segmented portion having short, wide segments, the distal portion

having the segments elongate; the sensory filament is borne on the 17th segment. The second antenna has a short basal segment, a long second segment bearing the one-segmented exopod, a longer and more slender third segment, and a short end

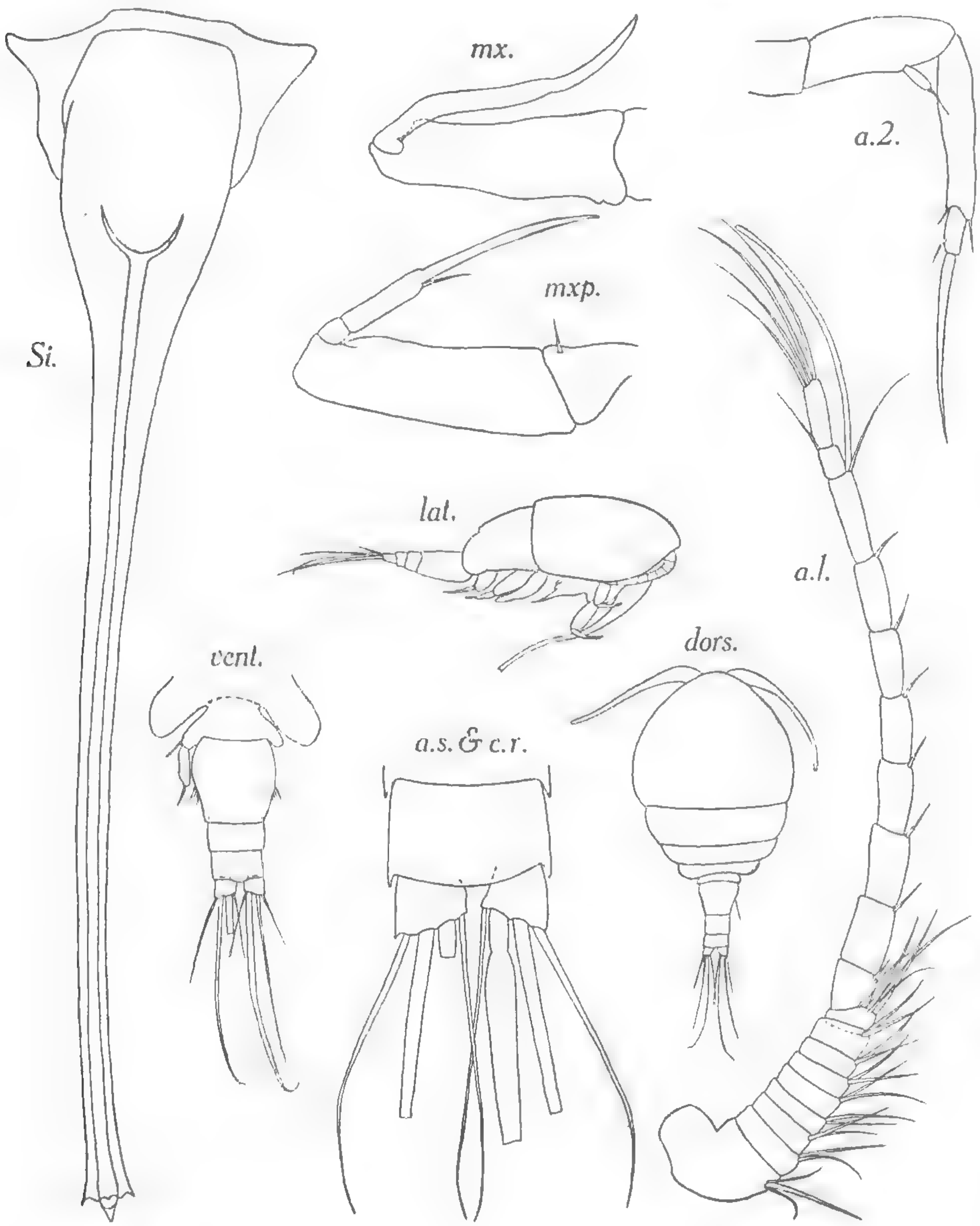

Fig. 7. *Scottocheres latus* sp. nov. Female ×38; urosome × 80; appendages × 240.

segment bearing a single large terminal spine and a short lateral seta. The siphon is long and slender, reaching to the posterior end of the metasome. The maxillule has a short outer lobe bearing one short and two long setae, and a long inner lobe similarly armed, though the setae are longer; it is like that of *elongatus* (as

shown by Sars, 1915). The maxilla and maxilliped are of stouter construction than in that species and the division of the terminal portion into segments is indistinct. The swimming legs are as in *elongatus*, with the following seta formula:

	endopod.	exopod.
p.1.	1.2.321.	1.1.223.
p.2.	1.2.321.	1.1.323.
p.3.	1.2.321.	1.1.323.
p.4.	1.2.221.	1.1.323.

This differs from *elongatus* in that the first endopod has two inner setae on the middle segment and both rami of the third and fourth legs have each a terminal seta and spine, as in the third endopod of *elongatus*. The fifth legs are elongate, with a single distal seta. The caudal rami have four terminal setae.

I have not been able to see a description of *S. stylifer*, but the present species differs from the others in having the anterior body considerably dilated, the genital segment as wide as long, rounded and without lateral teeth, the second and third segments of the urosome sub-equal, the terminal segment of the first antenna divided, the maxilla and maxilliped comparatively more robust, and the fifth leg extending to beyond the middle of the genital segment. It resembles *S. longifurca* in having the third and fourth segments of the first antenna separate and, as in *elongatus*, the caudal rami are sub-rectangular and about half as long as the anal segment.

FAMILY ACONTIOPHORIDAE Sars.

Sars, 1915, p. 109.

This monogeneric family was established by Sars (1915) for a genus which departed in several respects from the typical Asterocheridae.

Genus ACONTIOPHORUS Brady.

Brady. 1880, pp. 23, 69; Giesbrecht, 1897, p. 18; Sars, 1915, p. 110.

The name was first used by Brady *(loc. cit.)* in place of *Solenostoma* Brady and Robertson (1873), which was preoccupied. There are three species: *scutatus* (Brady and Robertson) 1873, syn. *angulatus* I. C. Thompson 1888; *ornatus* (Brady and Robertson) 1875, syn. *armatus* Brady, 1880; and *antennatus* Hansen, 1923. *A. elongatus* T. and A. Scott (1894) was made the type of Giesbrecht's new genus *Scottocheres (supra)*. A fourth species is described here.

KEY TO THE SPECIES OF ACONTIOPHORUS.

1. End segments of second antenna sub-equal .. .. 2.
   Distal segment twice as long as penultimate .. .. *antennatus* Hansen 1923.
2. Exopod of second antenna no longer than penultimate segment *ornatus* (Brady and Robertson) 1875.
   Exopod of second antenna longer than this segment .. .. 3.
3. Exopod of second antenna not reaching the middle of the terminal segment; caudal rami three times as long as wide .. .. *scutatus* (Brady and Robertson) 1873.
   Exopod of second antenna reaching beyond the middle of the terminal segment; caudal rami twice as long as wide .. .. *zealandicus* sp. nov.

ACONTIOPHORUS ZEALANDICUS sp. nov.

syn. *A. scutatus* (Brady and Robertson) G. M. Thomson, 1883.

Occurrence. IX, 1 female; XI, 3 females, 1 male; XII, 1 female.
Distribution. Otago Harbour, New Zealand.

Female. Length 0·95 - 1·04 mm. The body has the usual rounded shape of the genus, but the genital and pre-anal segments have posterior projections at their hinder ends. There is a well developed, pointed rostrum. The first antenna is 11-segmented, with a sensory filament on the eighth segment; the second antenna has a long exopod, extending to beyond the middle of the end segment.

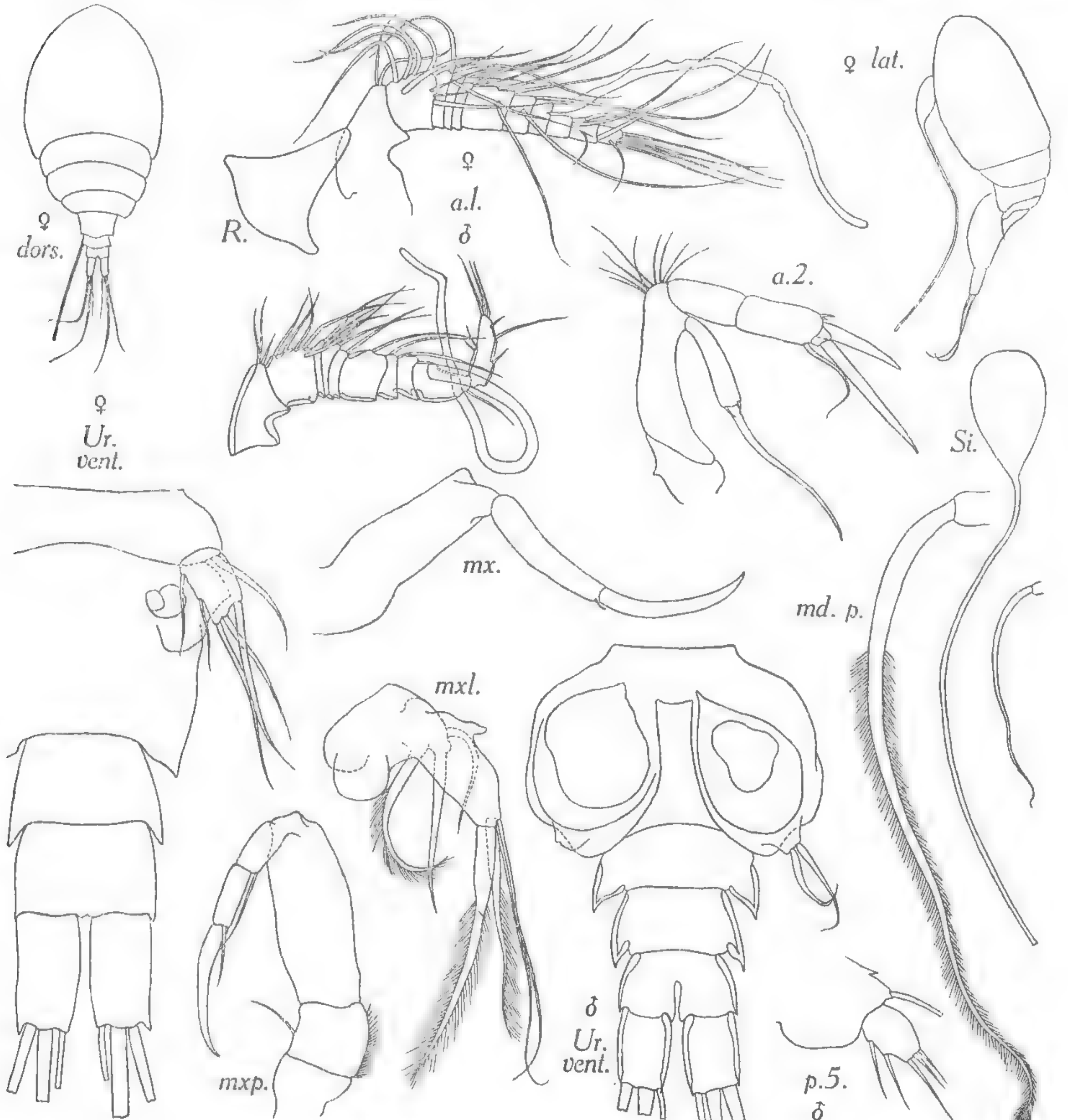

Fig. 8. *Acontiophorus zealandicus* sp. nov., male and female. Female × 32; urosome, both sexes, and siphon × 67; appendages × 200. The mandible palp is shown also at the same magnification as the siphon for comparison.

The siphon is very long, extending well beyond the caudal rami, almost reaching to the end of the caudal setae. The mandible palp is a long delicate seta, densely plumose for the greater part of its length. The maxillule has a short outer lobe with three setae, one of which is plumose, and a longer inner lobe with four setae, two of which are stouter than the others and plumose. The maxilla and maxilliped do not show any specific differences. The swimming legs are armed in a manner similar to those of *scutatus* (cf. Sars, 1915). The seta formula is as follows:

	endopod.	exopod.
p.1.	1,2.321.	1,1.323.
p.2.	1,2.321.	1,1.413.
p.3.	1,2.311.	1,1.313.
p.4.	1,2.211.	1,1.313.

The fifth legs are each represented by a well-developed, sub-rectangular segment bearing three terminal and two inner marginal setae; there is a single seta representing the basal segment which is fused with the corresponding body segment. The caudal rami are twice as long as wide and a little longer than the anal segment and armed with three terminal setae, the innermost of which is short and much more slender than the other two.

Male. Length 0·87 mm. The body is similar to that of the female; the urosome is 4-segmented with the three posterior segments sub-equal; the caudal rami are scarcely twice as long as wide. The first antenna is 10-segmented, having the third, fourth and fifth segments together scarcely more than half as long as the sixth, and the terminal segment distinctly hinged upon the preceding segment. In the second antenna the exopod extends to beyond the middle of the terminal segment, as in the female. There is little else to distinguish this from the female and it differs from the male of *scutatus* by the same features which separated the respective females, in addition to which the first antenna has only ten distinct segments compared with eleven in *scutatus*.

Thomson (1883, p. 115) states that the species found by him in Otago Bay "conforms exactly" with Brady's description of *scutatus*, which he quotes in full. Hansen (1923, p. 11) remarks in this connexion that Thomson is "most probably wrong." Hansen would appear to be correct here since the species found here, while closely resembling *scutatus*, differs from it in several respects in each of which, where comparison can be made, Thomson's figures show a similar difference. These differences are: in the first antenna in *scutatus* the third, fourth and fifth segments together equal the sixth; in *zealandicus* the sixth segment is considerably greater than these three together; in the second antenna of *scutatus* the exopod does not reach the middle of the terminal segment, whereas in *zealandicus* it extends beyond the middle; the caudal rami are more slender in *scutatus* (length/width: 3/1), in *zealandicus* this ratio is only 2/1. Thomson's figure shows the urosome somewhat upturned so that here no comparison can be made.

In view of these differences it seems probable that Thomson's specimen is identical with the new species described here.

FAMILY MYZOPONTIIDAE Sars.

Sars, 1915, p. 112.

This family was constituted by Sars for two genera which Giesbrecht had placed in his Dyspontiinae but Sars regarded as intermediate between this group and the Asterocheridae. The two genera are distinguished by the condition of the oral tube, which is short and not extended into a siphon in *Neopontius*, while *Myzopontius* has a well developed siphon.

Genus MYZOPONTIUS Giesbrecht.

Giesbrecht, 1895; 1897; 1899; Sars, 1915, p. 113.

This is a monotypic genus based on Giesbrecht's *M. pungens*. The form found here differs in the first antennae and caudal rami and is regarded as a new species.

MYZOPONTIUS AUSTRALIS sp. nov.

Occurrence. X1, 1 female.

Female. Length 0·87 mm. The body has the same general shape and pro-

portions as in *pungens.* The first antenna has nine distinct segments, with comparatively few setae; the remaining head appendages are much as in the type species but the maxilla has only three inner spinules on the claw and the maxilliped is somewhat bent instead of having straight sides. The legs are like those of *pungens* with the following seta formula:

	endopod.	exopod.
p.1.	1.2.321.	1.1.323.
p.2.	1.2.321.	1.1.423.
p.3.	1.2.321.	1.1.423.
p.4.	1.2.221.	1.1.423.

The fifth legs are about twice as long as wide with two terminal and one inner setae. The caudal rami are stoutly built and less than twice as long as wide. The male is unknown.

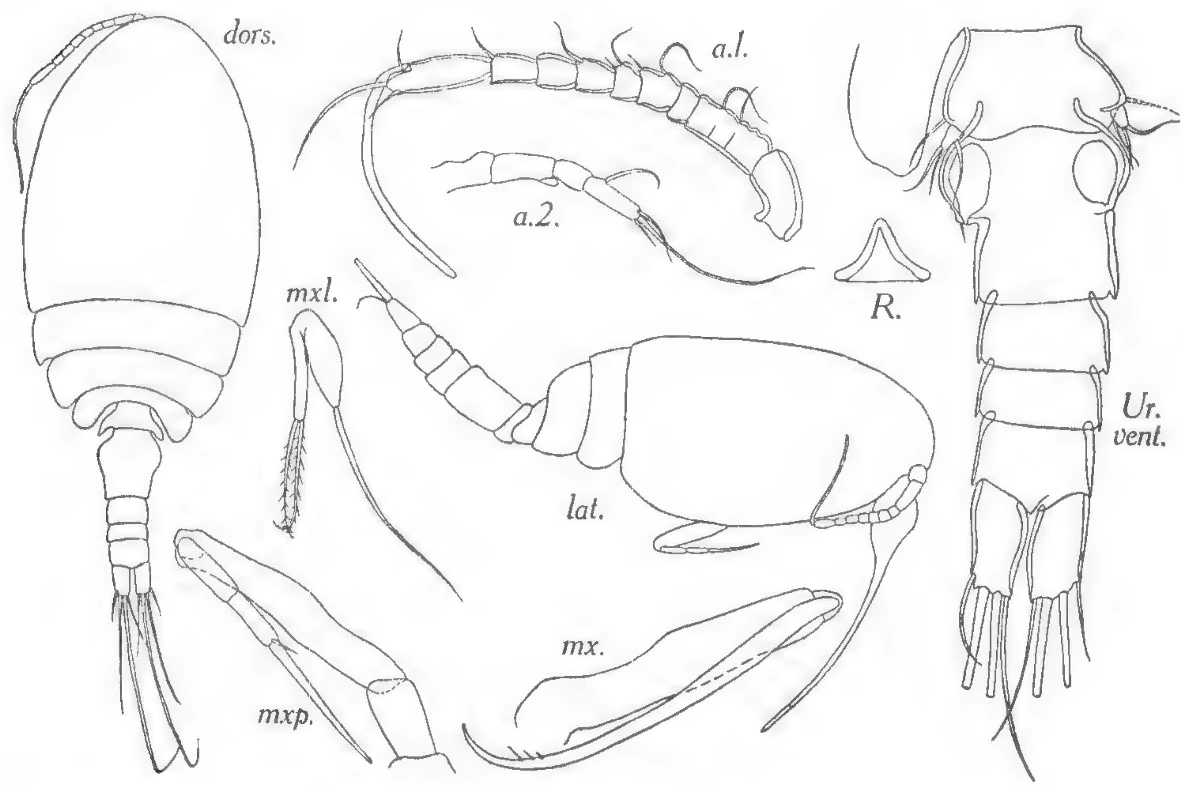

Fig. 9. *Myzopontius australis* sp. nov. Female × 67; urosome and appendages × 200.

FAMILY DYSPONTIIDAE Sars.

Sars, 1915, p. 117.

A key to the genera of this family is given below in which certain genera not referred to by Sars *(loc. cit.)* but identifiable as belonging to the family have been included. It should perhaps be noted here that *Pteropontius* has found its way into the wrong group in Wilson's (1923) key to the Cyclopoida. This genus is characterized by having both rami of the first legs only 2-segmented. Two of the new genera described by Thompson and Scott (1903) are recognizable as belonging to this family. *Metapontius* Hansen (1923) also belongs here and *Urogonia* Brady (1910) probably does, though as with so many of the descriptions in this paper it is too meagre for certain identification. An interesting form occurred in this collection from South Australia, for which a new genus has been required, and will be described below.

The features distinguishing *Cryptopontius* from *Dyspontius* given by Giesbrecht (1899, p. 114) would appear to be better than those used by Wilson (1932, p. 594) since the length of the siphon varies in both genera. The most reliable character is the armature of the first exopod: *Dyspontius* has only two outer spines on the end segment whereas *Cryptopontius* has three.

KEY TO THE GENERA.

1. Rami of first four pairs of legs 3-segmented .. .. 2.
   Rami of first three pairs of legs 3-segmented, fourth pair different .. .. 5.
   Rami of first pair 2-segmented, fourth legs without endopods *Pteropontius* Giesbrecht 1895.
2. Second antenna biramous .. .. 3.
   Second antenna uniramous, 4-segmented .. .. .. *Urogonia* Brady 1910.
3. Fourth endopods reduced in size, with small setae; maxillae and maxillipeds of slender structure .. .. *Bradypontius* Giesbrecht 1895.
   Fourth endopods not reduced, setae normal; maxillae and maxillipeds strongly built .. 4.
4. Posterior corners of head conspicuously notched; epimeral plates pointed diagonally outwards; genital segment about as wide as long .. *Cribropontius* Giesbrecht 1899.
   Posterior corners of head entire; epimeral plates curved backwards parallel with body axis; genital segment twice as wide as long .. .. *Sestropontius* Giesbrecht 1899.
5. Fourth endopod 2-segmented .. .. 6.
   Fourth endopod replaced by a process, seta, spine, or lacking .. .. .. 8.
6. Body longer than wide, thoracic segments free; urosome 4-segmented in female, forming one-fourth of total length .. .. 7.
   Body as wide as long, sub-circular, third and fourth thoracic segments fused; urosome 3-segmented in female, less than one-sixth of total length .. .. *Discopontius* gen. nov.
7. Body with well developed epimera; siphon short and slender, with suctorial tube *Arctopontius* Sars 1915.
   Body without epimera, segments rounded; siphon short and stout, without suctorial tube *Metapontius* Hansen 1923.
8. Second antenna 5-segmented, second segment with 2-segmented exopod; first antenna 18-segmented; urosome 3-segmented, last two segments very short *Cletopontius* Thompson and Scott 1903.
   Second antenna 4-segmented, second segment with one-segmented exopod .. .. 9.
9. Urosome 3-segmented, completely covered by last metasome segment, fifth legs 15 times as long as wide .. .. .. *Lepeopsyllus* Thompson and Scott 1903.
   Urosome entirely free dorsally; fifth legs as wide as long .. .. .. 10.
10. Head wider than long; distal segment of first exopod with two spines *Dyspontius* Thorell 1889.
    Head longer than wide; distal segment of first exopod with three spines *Cryptopontius* Giesbrecht 1899.

Genus CRYPTOPONTIUS Giesbrecht.

Giesbrecht, 1899, pp. 30, 89, 108; Sars, 1915, p. 120.

The genus contains six species: *thorelli, tenuis, capitalis* and *brevifurcatus* (Giesbrecht) 1895; *innominatus* Brady 1910, and *gracilis* Wilson, 1932a. Four new species are described below and a key is given for the identification of the various species.

KEY TO THE FEMALES.

1. Caudal rami wider than long .. .. 2.
   Caudal rami at least as long as wide .. .. 3.
2. Urosome forming little more than one-fifth of the total length *brevifurcatus* (Giesbrecht).
   Urosome forming at least one-fourth of the total length .. *longipes* sp. nov.
3. First antenna with second segment shorter than first and third .. .. .. 4.
   First antenna with second segment longer than either first or third ..*innominatus* Brady.
   First antenna with first two segments sub-equal .. .. *proximus* sp. nov.
4. Siphon reaches beyond the base of the first legs .. .. 5.
   Siphon does not reach the base of the first legs .. .. 8.

5. First antenna 10- or 11-segmented .. .. 6.
First antenna 9-segmented .. .. 7.

6. Exopod of second antenna with two setae; end segment of first exopod with two inner setae *thorelli* (Giesbrecht)
Exopod of second antenna without setae; end segment of first exopod with three inner setae *similis* sp. nov.

7. Width of cephalosome about four-fifths of its length .. *tenuis* (Giesbrecht).
Width of cephalosome equal to its length .. .. *gracilis* Wilson.

8. First antenna 10-segmented; exopod of second antenna with two setae; inner lobe of maxillule with long plumose seta .. .. .. *capitalis* (Giesbrecht).
First antenna 9-segmented; exopod of second antenna without setae; inner lobe of maxillule with short seta .. .. *latus* sp. nov.

It is uncertain whether *innominatus* should have been included. Brady's specimen was apparently damaged, but the urosome which he figures shows the genital segment of the same width throughout, whereas it is characteristic of the genus that it should be very much widened anteriorly.

CRYPTOPONTIUS SIMILIS sp. nov.

Occurrence. X, 1 female, 1 male.

Female. Length 1·30 mm. The body is of similar shape and proportions to *thorelli*, though less acutely pointed anteriorly. The first antenna is 10-segmented, with the third to seventh and ninth to eleventh segments fused. The second antenna has a small unarmed exopod; the end segment is without lateral setae but has a row of fine hairs. The siphon reaches to the base of the first legs but not beyond. The maxillule has both lobes slender, the outer two-thirds as long as the inner and armed with a short seta and small spine, the inner lobe armed with two slender spines. The maxilla and maxilliped are very like those of *thorelli*. The swimming legs are normal, with the following seta formula:

	endopod.	exopod.
p.1.	1.2.321.	1.1.323.
p.2.	1.2.321.	1.1.423.
p.3.	1.2.321.	1.1.423.
p.4.	—	1.1.423.

The fifth leg is twice as long as wide, with one spine and a seta. The caudal rami are longer than wide (about 4 : 3).

Male. Length 1·02 mm. The body is more slender than that of the female, as is usual in this genus, and the urosome is five-segmented. The first antenna has eleven distinct segments, the large sensory filament being placed sub-terminally on the end segment. There is a series of long thin sensory filaments distributed as follows: one on the second and eighth segments, two on the sixth and ninth and four on the third segment. The ninth segment also has two short spines near the bases of the filaments. The mouth parts and legs are as in the female and the caudal rami have a similar proportion and armature.

This species is very close to *thorelli*, particularly in the shape and proportions of the body, its size, the first antennae, maxillae and maxillipeds. It differs in the proportions and armature of the maxillule and in the armature of the second antenna and first leg. In this leg in *thorelli* the seta formula is 1·1·321; 1·1·223. It is unfortunate that Giesbrecht (1899) has not illustrated the fourth legs of the species of this genus described therein as there is some variation in the second segment of the basipod of this leg in the species found here. In this species there is a small prominence on this segment, which may represent the missing endopod. In *longipes*, described below, this prominence is well developed, whereas the two other species described here are without any such prominence.

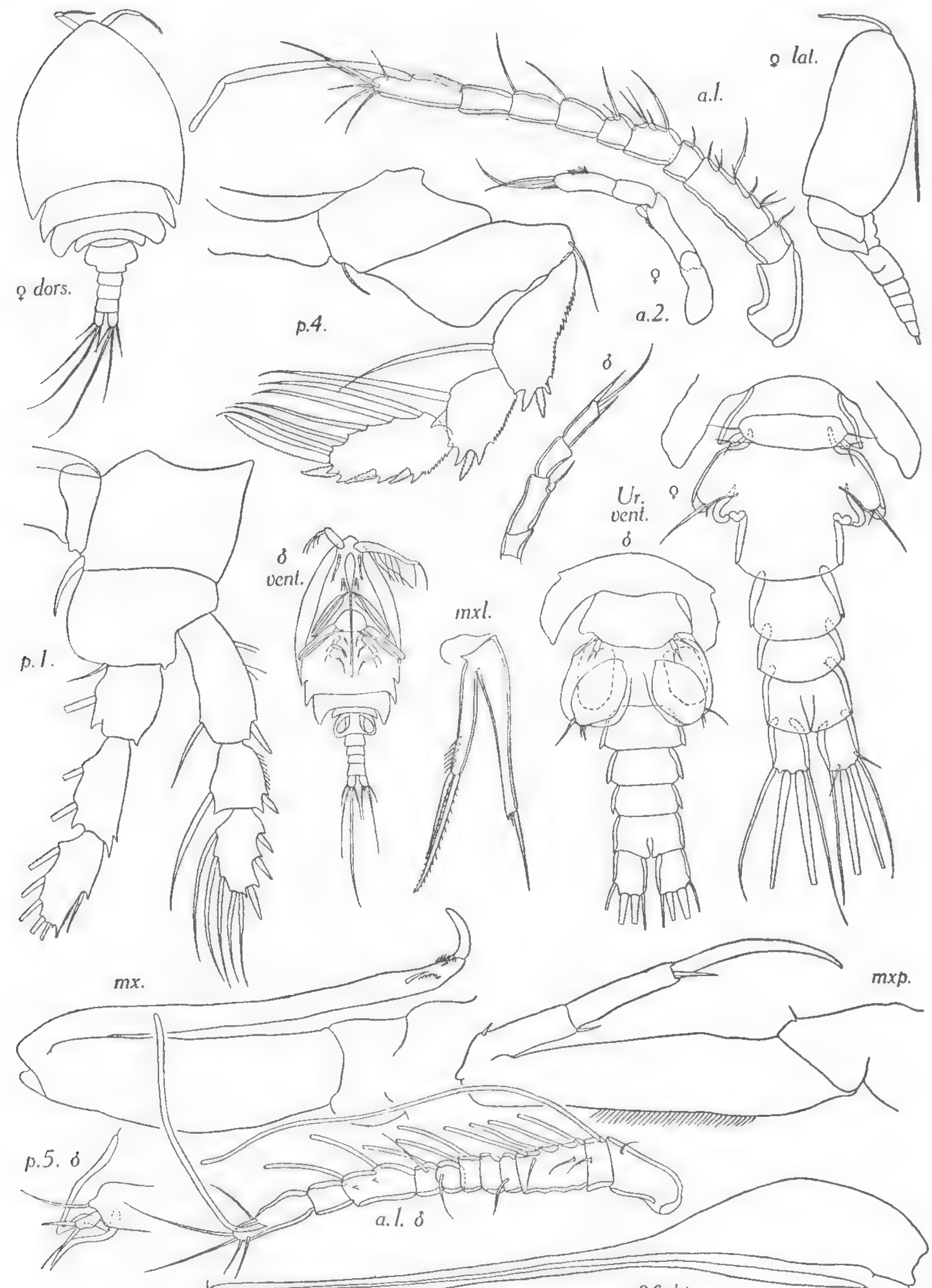

Fig. 10. *Cryptopontius similis* sp. nov. Male and female × 30; urosome, both sexes, × 110; appendages × 185.

CRYPTOPONTIUS LATUS sp. nov.

Occurrence. XII, 1 female.

Female. Length 1·30 mm. The body is of similar proportions and size to *capitalis,* having the head segment distinctly wider than long. The first antenna is 9-segmented, the third to seventh and eighth to tenth segments being fused.

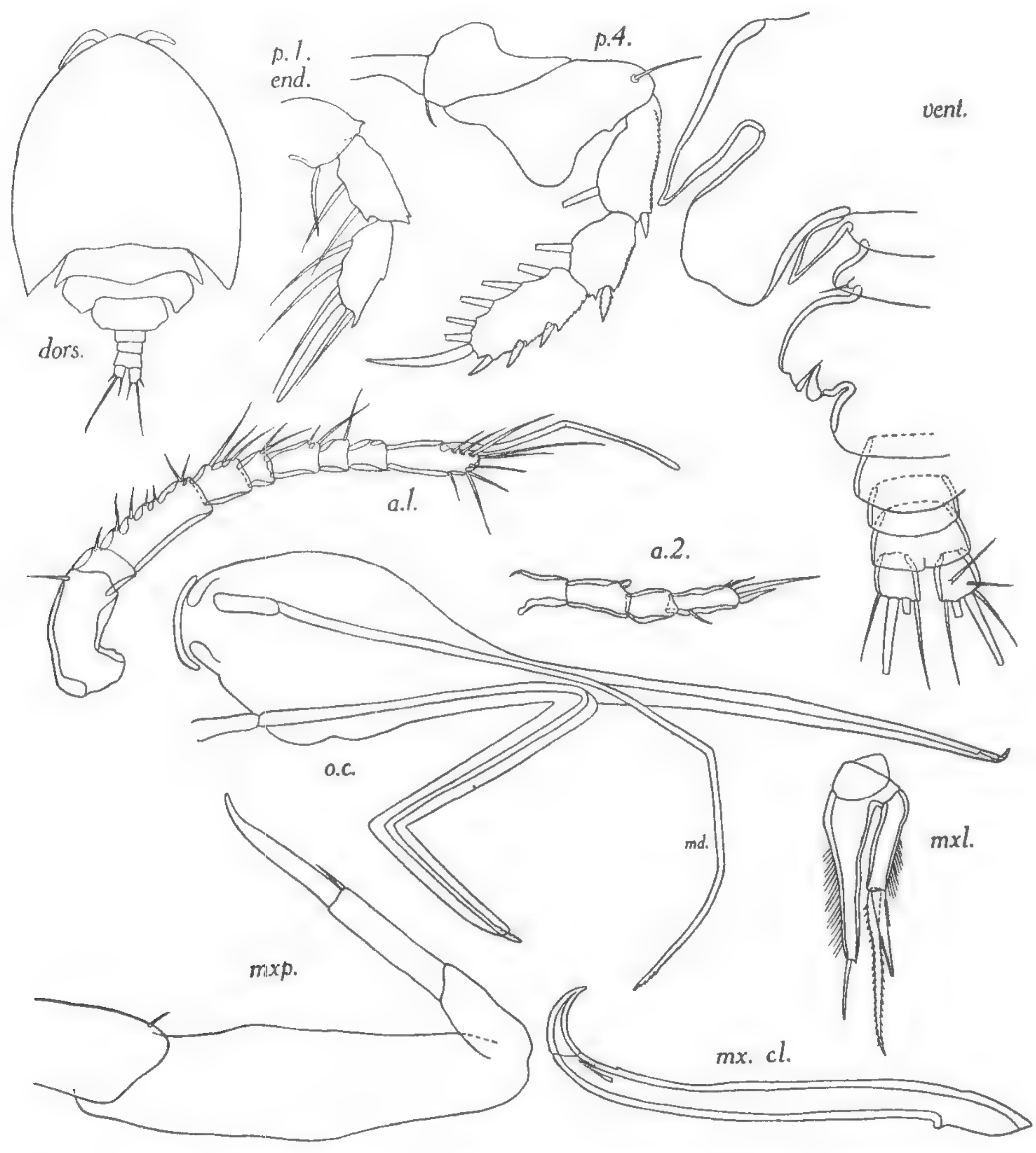

Fig. 11. *Cryptopontius latus* sp. nov. Female × 32; urosome × 120; appendages × 200.

The second antenna has a very small, unarmed exopod, the end segment has a lateral seta and two terminal spines and a small seta. The siphon is very short, not reaching the base of the first legs. The maxillule has two strong spines on the outer lobe and a single short seta on the inner. The maxilla has the terminal portion of the claw fused with the proximal portion and strongly curved. The swimming legs have the following seta formula:

	endopod.	exopod.
p.1.	1.2.320.	1.1.223.
p.2.	1.2.321.	1.1.423.
p.3.	1.2.321.	1.1.423.
p.4.	—	1.1.423.

The fifth legs are composed of small rounded knobs, each bearing a single seta. The caudal rami are as long as wide.

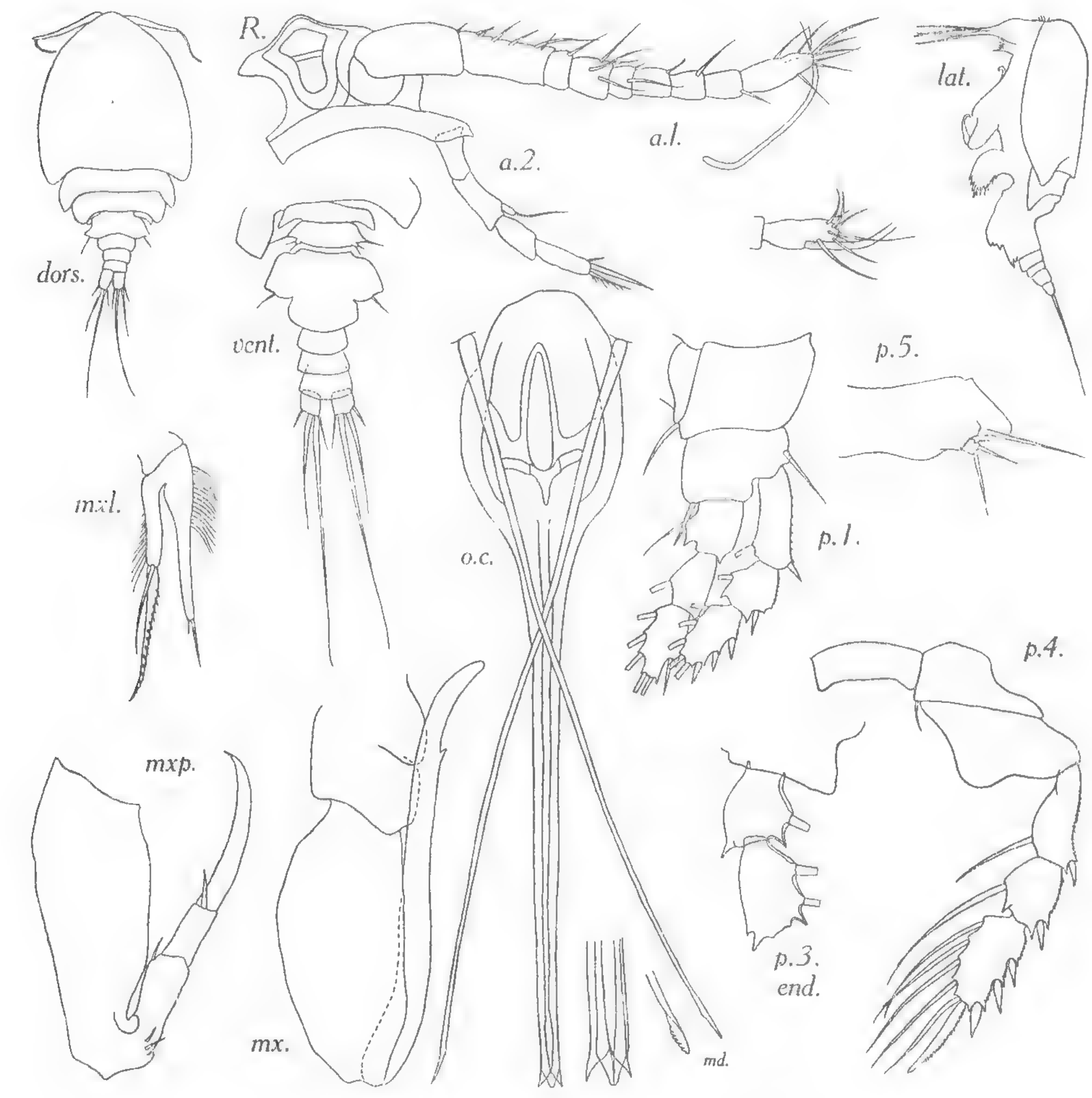

Fig. 12. *Cryptopontius proximus* sp. nov. Female × 32; urosome × 67; appendages × 200; terminal portions of siphon and mandible × 333.

This species approaches *capitalis* very closely and should perhaps be identified with that species, but there are several minor points of difference. In *capitalis* the eighth segment of the first antenna is free, whereas here it is fused with the ninth and tenth; the inner lobe of the maxillule has a single relatively short unarmed seta in place of the longer plumose seta and small spur of Giesbrecht's species; the exopod of the second antenna is unarmed.

It is regrettable that the species of this genus found here (with one exception) occurred as isolated specimens, since the examination of a series might show sufficient variation to permit of this species and *similis* being included in *capitalis* and *thorelli* respectively.

CRYPTOPONTIUS PROXIMUS sp. nov.

Occurrence. IX, 1 female.

Female. Length 1·02 mm. The body is much as in *similis,* having the head segment about as wide as long, but the first free thoracic segment has the lateral projections more rounded. The first antenna is 9-segmented, the first two segments sub-equal, the second to seventh and ninth and tenth being fused. In the second antenna the exopod bears a single long terminal seta, and the end segment one spine and two setae. The siphon scarcely reaches the base of the first legs. The maxillule has slender lobes, the outer armed with a stout spine and a shorter seta, the inner with a very short seta and small spine. The maxilla has the terminal portion undivided and ends in a blunt curved claw. The swimming legs have their seta formula as follows:

	endopod.	exopod.
p.1.	1.1.321.	1.1.323.
p.2.	1.2.321.	1.1.423.
p.3.	1.2.321.	1.1.423.
p.4.	—	1.1.423.

The fifth legs are almost square, with two terminal and one lateral setae and the caudal rami are a little longer than wide.

This species resembles *similis* in the shape of the body, but in other features it approaches more closely to *latus.* It differs in several particulars: in the first and second antenna, the armature of the first legs and in the fifth legs. The siphon also is relatively longer and the species is considerably smaller than *similis.*

CRYPTOPONTIUS LONGIPES sp. nov.

Occurrence. IX, 3 females; X, 2 males; XII, 1 male; XIII, 1 male.

Female. Length 1·13 mm. The body is comparatively slender, its width less than half the total length; the width of the head segment is five-sixths of its length. In the urosome the genital segment has a comparatively short undilated posterior portion, which is wider than the following segments. Of these the first two are short and sub-equal and together no longer than the anal segment. The caudal rami are wider than long.

The first antenna is 9-segmented, the first two segments are sub-equal, the second to seventh and ninth and tenth being fused. The second antenna has a very short basal segment; the exopod is minute and unarmed; the end segment has no lateral seta but a fringe of hairs, and two unequal terminal setae. The siphon is comparatively long, reaching beyond the base of the first legs. The maxillule has two stout spines on the outer lobe and two long delicate setae on the inner lobe. The maxilla has the terminal part of the claw separated from the proximal portion and the maxilliped has the two distal segments fused. The seta formula for the swimming legs is:

	endopod.	exopod.
p.1.	1.?.320.	1.1.223.
p.2.	1.2.321.	1.1.423.
p.3.	1.2.321.	1.1.423.
p.4.	—	1.1.423.

The armature of the first legs is somewhat uncertain, as these were so strongly curved inwards and forwards that on mounting they broke up and the setae were

dislodged, or the rami overlapped to such an extent as to make it difficult to be certain of the setae. The fourth legs are distinguished from those of other species found here by the presence of a well-developed prominence on the basipod, adjacent to the exopod. The distal segment of the leg on one side had only three

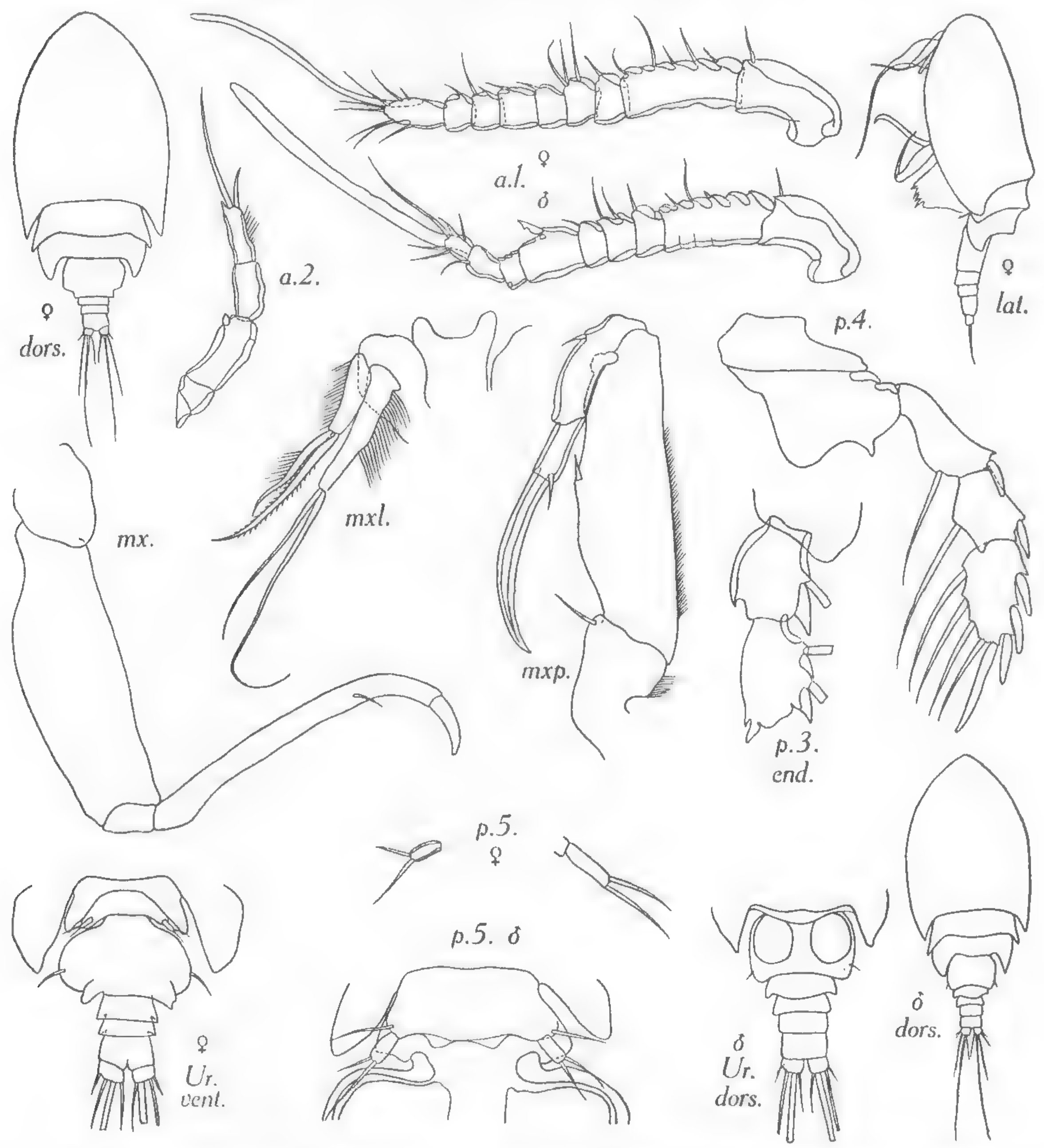

Fig. 13. ***Cryptopontius longipes*** **sp. nov. Male and female × 32; urosome, both sexes, × 67; appendages × 200.**

inner setae, instead of four, which is the more usual number. The fifth legs also distinguish this species from any other in that they are more than twice as long as wide; in one specimen they were nearly four times as long as wide.

Male. Length 1·04 - 1·15 mm. The body is more slender than that of the female. The first antenna is 9-segmented, with the first two segments sub-equal and showing a fusion of segments similar to that of the female. The sixth free segment is elongate and bears a barbed spine; the terminal portion, consisting of

two segments, is weakly geniculate upon the preceding segment. The fifth legs are somewhat shorter than in the female but twice as long as wide, and similarly armed. Apart from the 5-segmented urosome, the male resembles the female in all other respects.

This species is distinguished from all the other species by the genital segment and urosome of the female and by the elongate fifth leg. It resembles *brevifurcatus* in having the caudal rami wider than long, but differs from it in so many respects that it must be regarded as distinct.

DISCOPONTIUS gen. nov.

Body sub-circular in outline, with a small projecting urosome, and the whole considerably flattened so as to be disc shaped. The segments are without epimeral plates and the first segment is fused with the head; the third and fourth segments are fused and completely cover the fifth segment dorsally. The urosome is very short, 3-segmented; the genital segment is greatly enlarged and longer than the rest of the urosome, including the caudal rami, and a little more than three times as wide as the other urosome segments. The mouth parts in general show the characters of the family. The first three pairs of legs have 3-segmented rami, the exopod of the fourth pair is 3-segmented and the endopod 2-segmented with reduced setae. The fifth legs are well developed, 1-segmented, and project posteriorly from beneath the metasome.

In the condition of the swimming legs this genus approaches *Arctopontius*: the first three pairs have normal rami while in the fourth pair the endopod is reduced to two segments. Sars' genus moreover has a somewhat expanded metasome and the cephalic appendages are not unlike those of his genus. The first antenna is of similar structure, though the sensory filament is sub-terminal; the second antenna has the second and third segments considerably larger than either first or fourth, whereas in *Arctopontius* they are sub-equal. The siphon is less produced than in Sars' genus, but the maxilla and maxilliped are very similar. In *Discopontius* the body is sub-circular in outline and the female urosome is 3-segmented (in *Arctopontius* 4-segmented); the third and fourth metasome segments are fused, an unusual feature, and dorsally cover the free fifth segment. These segments are all without epimeral plates, whereas in Sars' genus the segments are distinct and have well-developed epimera. The genital segment is enlarged in both. In conformity with the flattened body the bases of the swimming legs are very wide; the fifth legs are well-developed, whereas in *Arctopontius* they are represented only by setae. In shape this genus resembles *Doropontius* Thompson and Scott (1903), but their genus is clearly an Asterocherid in structure. *Cletopontius* of the same authors is also of a similar appearance, and belongs to the Dyspontiidae, but differs in many respects, particularly the second antenna, maxilla, and fourth legs in which there is no endopod. The urosome is also 3-segmented in *Cletopontius*, but the anal segment is no larger than the pre-anal, whereas here it is twice as large.

DISCOPONTIUS DISCOIDES sp. nov.

Occurrence. IX, 1 female.

Female. Length 0·74 mm.; width 0·67 mm. The body has been described under the characters of the genus. The first antenna has thirteen distinct segments, with a sensory filament distally on the eleventh; the second to eighth segments are fused. The second antenna is 4-segmented, with a small exopod attached to the second segment at a little past the middle; the fourth segment is very short and bears terminally one spine and two setae. The oral cone is short and stout, slightly produced into a siphon. The maxillule has a short slender outer

lobe, with a single seta and a longer stouter inner lobe bearing four setae. The maxilla and maxilliped are of very strong construction, resembling those of *Arctopontius,* but the distal portion of the maxillary claw is not divided from the proxi-

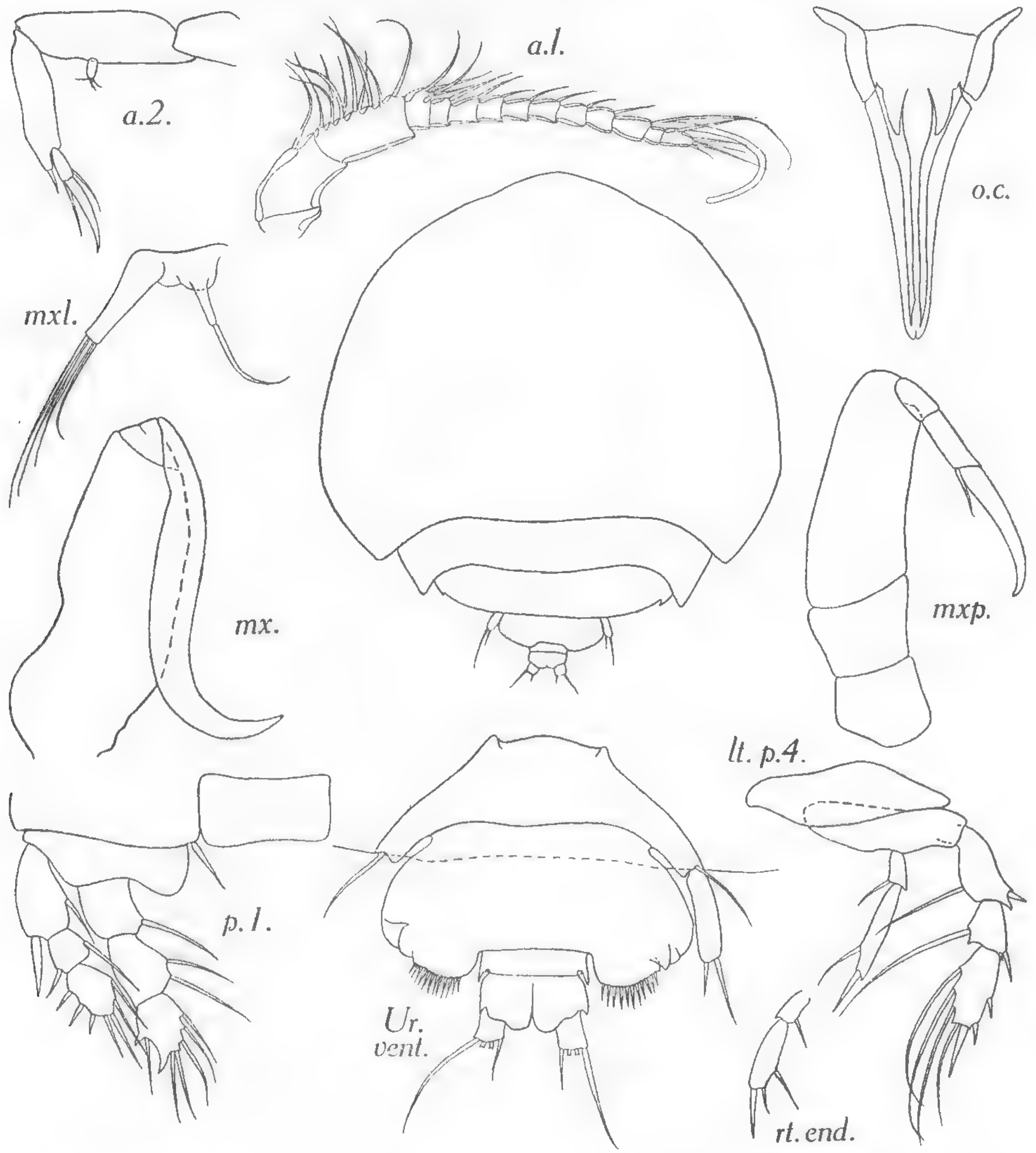

Fig. 14. *Discopontius discoides* gen. et sp. nov. Female × 80; urosome and appendages × 240.

mal portion. The swimming legs have 3-segmented rami, except the fourth endopod, which is 2-segmented and with reduced setae. The seta formula is:

	endopod.	exopod.
p.1.	1.2.321.	1.1.223.
p.2.	1.2.321.	1.1.323.
p.3.	1.2.321.	1.1.323.
p.4.	—	1.1.322.

The fourth endopod was of slightly different structure on opposite sides; that on the left leg had a longer distal segment with one inner seta and a terminal spine; on the right leg the distal segment had a small terminal seta as well as the spine. The fifth leg is one-segmented, the basal segment being fused with the body; the distal segment is four times as long as wide, curved, and reaches to the middle of the pre-anal segment. The caudal rami are slightly longer than wide, though shorter than the anal segment, and armed with four terminal setae, the two middle ones of which were broken so that their length is unknown. The genital segment is armed along its posterior margin with a fringe of short spines. No egg-sacs were present. The male is unknown.

Genus BRADYPONTIUS Giesbrecht.

Giesbrecht, 1895, 1899, pp. 88, 107; Sars, 1915, p. 124.

One of the most characteristic features of this genus is the endopod of the fourth leg, which is always more slender than the exopod and has the setae reduced in number and size while retaining the full number of segments.

There are twelve species in the genus: *magniceps* (Brady), 1880; *papillatus* (T. Scott), 1888; *chelifer* and *siphonatus* Giesbrecht, 1895; *ignotus* and *serrulatus* Brady, 1910; *major* and *caudatus* Sars, 1915; *groenlandicus, dentatus, unidens* and *tenuipes* Hansen, 1923.

It should be noted that Sars (*loc. cit.*, p. 127), regards *chelifer* as a synonym of *papillatus*; it would appear, however, that the differences are sufficiently marked for it to be regarded as distinct. Three new species have been found in this collection and a key is given for their identification from which only *dentatus* has been excluded because the specimen described by Hansen was so damaged as to render impossible the description of the legs.

KEY TO THE SPECIES (BOTH SEXES).

1.	Fifth leg reduced to small round knobs, not more than twice as long as wide	2.
	Fifth leg elongate, about five times as long as wide	♀ *tenuipes* Hansen 1923.
2.	Fourth endopod with inner seta on the basal segment and usually two setae on the middle segment	3.
	Fourth endopod without inner seta on the basal segment and never more than one on the middle segment	10.
3.	Fourth endopod with five setae on the terminal segment	4.
	Fourth endopod with four setae on the terminal segment	7.
4.	First antenna 12- or 13-segmented	5.
	First antenna 8-segmented	♀ *magniceps* (Brady) 1880.
5.	Middle segment of fourth endopod nearly twice as long as the basal segment	♂♀ *caudatus* Sars 1915[3].
	Middle segment of fourth endopod little longer than the basal segment	6.
6.	Claw of maxilla with lateral spine and spur	♀ *major* Sars 1915.
	Claw of maxilla with lateral spine and denticles, no spur	♂ *unidens* Hansen 1923.
7.	First antenna 11-segmented in female, 13-segmented in male	♂♀ *groenlandicus* Hansen 1923.
	First antenna 8- or 9-segmented in female, 11-segmented in male	8.
8.	Fourth endopod without setae on middle segment	♀ *serrulatus* Bray 1910.
	Fourth endopod with two setae on middle segment	9.
9.	Fourth endopod as long as exopod	♀ *ignotus* Brady 1910.
	Fourth endopod much shorter than exopod	♂♀ *papillatus* (T. Scott) 1888.
10.	Caudal rami at least as long as wide	11.
	Caudal rami wider than long	13.

(3) Sars (1915, p. 129) in a footnote states that the male identified as that of *major* is more probably that of *caudatus*.

11. First antenna 8-segmented in female, 11- or 12-segmented in male; distal segment of fourth endopod the longest .. .. 12.
First antenna 9-segmented in female; proximal segment of fourth endopod the longest ♀ *serratipes* sp. nov.
12. Caudal rami longer than wide .. .. ♂♀ *chelifer* Giesbrecht 1895.
Caudal rami as wide as long .. .. ♂ *ovatus* sp. nov.
13. First antenna 10-segmented in female, 12-segmented in male ♂♀ *siphonatus* Giesbrecht 1895.
First antenna 9-segmented in female, 11-segmented in male .. ♂♀ *inermis* sp. nov.

BRADYPONTIUS INERMIS sp. nov.

Occurrence. IX, 2 females; X, 4 females (1 ovigerous), 1 male, 3 juveniles; XI, 17 females; XII, 1 juvenile ?; XIII, 4 females (2 ovigerous).

Female. Length 1·11 - 1·50 m.m. The body is wide anteriorly, its greatest width being about three-fifths of the total length; the head segment is as wide as long. The first antenna is composed of nine distinct segments, the second to seventh and ninth and tenth being fused; the second segment is partially separated in some specimens and entirely free in others; when it is free, then the eighth segment is fused with the preceding segment so that the total number is always nine. The second antenna has a small exopod bearing two small setae. The siphon extends beyond the posterior margin of the head segment. The maxillule has the outer lobe armed with one spine and a thin seta, and the inner lobe has a single long delicate seta; the maxilla and maxilliped are without specific characteristics. The swimming legs have the following seta formula:

	endopod.	exopod.
p.1.	1.2.320.	1.1.323.
p.2.	1.2.321.	1.1.423.
p.3.	1.2.321.	1.1.423.
p.4.	0.0.010.	1.1.423.

As is usual in this genus in preserved specimens the swimming legs are found with the rami bent forwards and inwards so that they tend to overlap when mounted. The second leg, which has been figured, has been drawn with the rami artificially separated. The fifth leg is composed of a rounded knob, bearing two setae. The caudal rami are wider than long and about half the length of the anal segment.

Male. Length 1·07 mm. The body is more slender than that of the female, the width of the head being only three-fourths of its length. The first antenna has eleven distinct segments, the third to sixth being fused; the ninth segment is elongate and bears a distal hook, while the terminal segment is bent upon the tenth segment and bears a long stout sensory filament. Segments two to nine bear a large number of very thin sensory filaments, little thicker than an ordinary seta. These are very long and only a few have been shown in the figure; the impression gained from an examination of the whole animal is that the antennae are clothed with a brush of dense setae.

Giesbrecht (1899, p. 29) states that the males in both *chelifer* and *siphonatus* have a large number of long thin sensory filaments one on each free and fused segment from two to twelve (eighth segment excepted in *chelifer)* and two on each from thirteen to sixteen. In this species the distribution is from segments two to nine (distinct segments) but the proximal ones overlie the points of attachment of the more distal ones so as partially to hide the points of insertion. There are between sixty and seventy altogether.

The second antenna bears a lateral seta on the end segment, not found in the female (possibly broken off) and the maxilliped shows the modification of the basal portion found in the male of *siphonatus*.

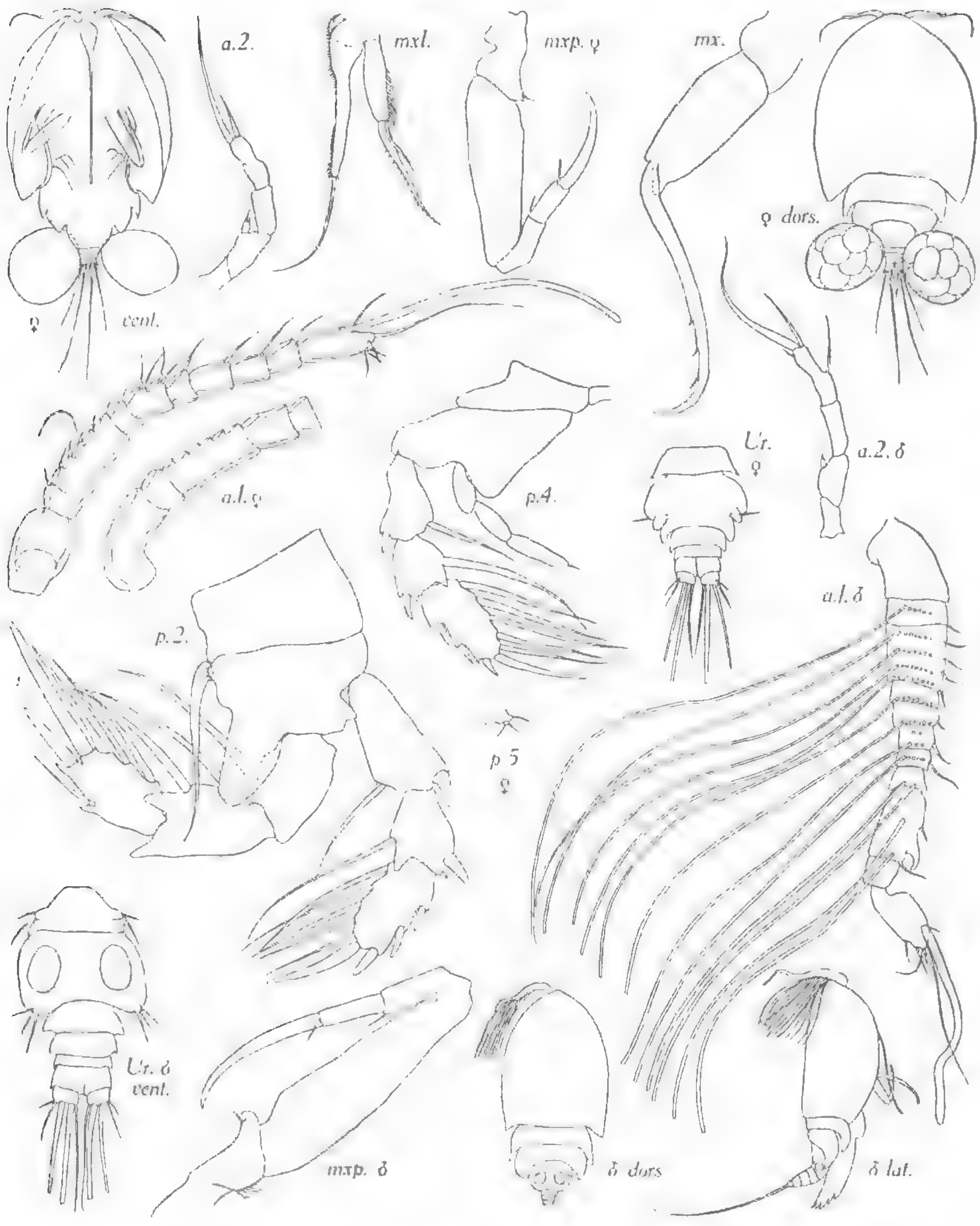

Fig. 15. *Bradypontius inermis* sp. nov. Male and female × 27; urosome of female × 57; maxilla, maxilliped, and fifth legs of female, and urosome of male × 103; other appendages × 171.

The species resembles *siphonatus* in a number of features, but differs in the shape of the body in the male, the first antenna in both sexes, the proportions of the segments in both second antenna and maxillule, the rather more robust maxilliped in the female, and the armature of the fourth endopod. These two species are the only ones described as having the caudal rami wider than long.

BRADYPONTIUS SERRATIPES sp. nov.

Occurrence. XII, 1 female.

Female. Length 1·52 mm. The body is comparatively slender, its greatest width being about half the total length; the head segment is longer than wide and the urosome forms about one-third of the total length. The first antenna has nine distinct segments, the third to eighth and ninth and tenth being fused.

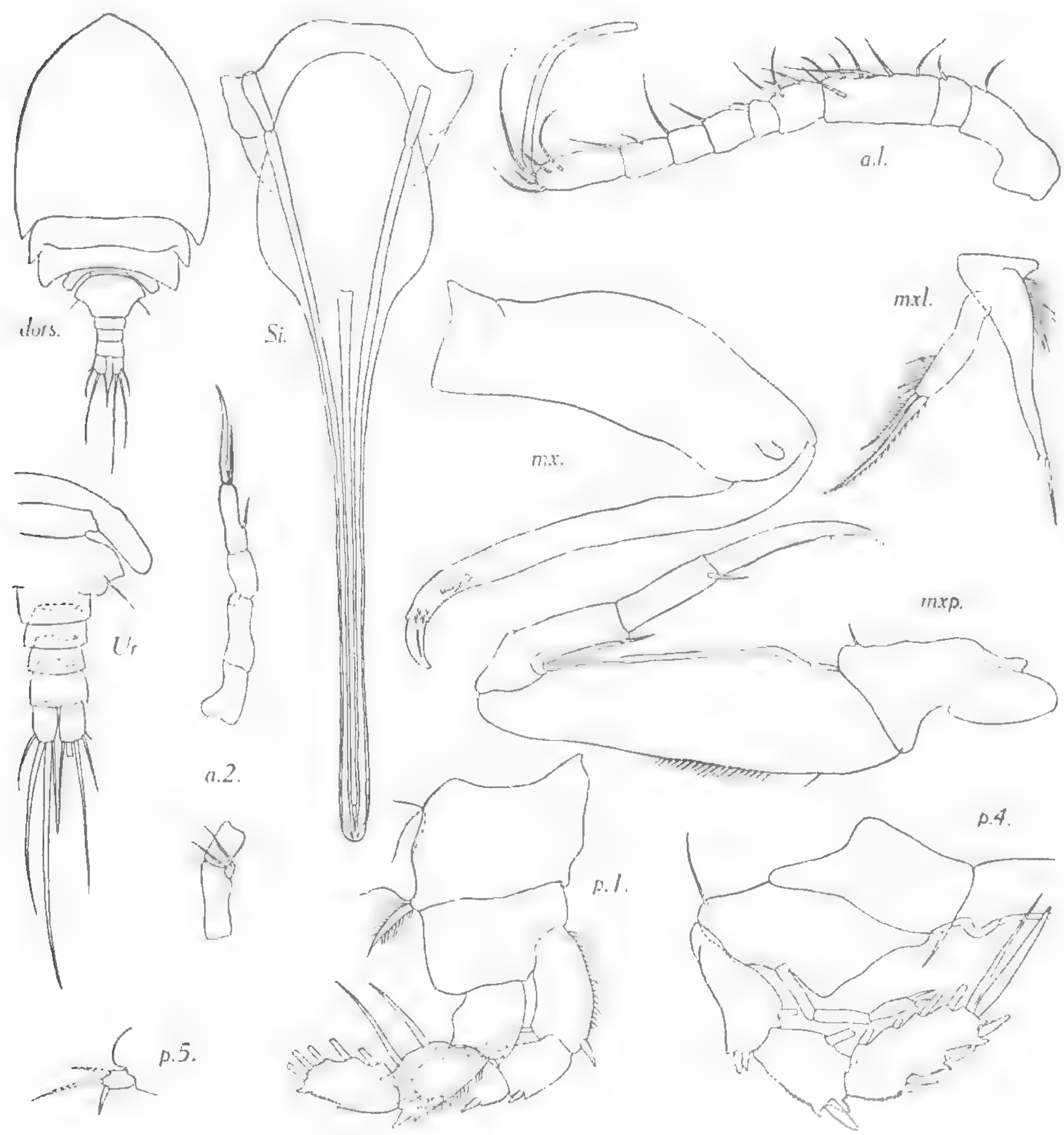

Fig. 16. *Bradypontius serratipes* sp. nov. Female × 27; urosome × 57; appendages × 171.

The exopod of the second antenna has two long setae, the end segment has a lateral seta as well as the terminal seta and spine. The siphon is short, not reaching the base of the first legs. The maxillule has a short terminal seta on the inner lobe; the maxilla and maxilliped are stoutly constructed. The outer margins of

the exopods of legs two to four are strongly serrate, that of the first leg less so. Seta formula:

	endopod.	exopod.
p.1.	0.2.320.	1.1.323.
p.2.	1.2.321.	1.1.423.
p.3.	1.2.321.	1.1.423.
p.4.	0.0.020.	1.1.423.

The fifth leg is short, sub-rectangular, not twice as long as wide and with probably three setae, only one of which was seen. The caudal rami are less than twice as long as wide and about as long as the anal segment.

The species resembles *chelifer* in some respects, but is more slender, has the second segment of the first antenna free, and lacks the inner setae on the second and third segments of the fourth exopod present in that species. The serrations on the exopods are also probably more strongly developed.

BRADYPONTIUS OVATUS sp. nov.

Occurrence. XI, 2 males.

Female unknown. Male. Length 0·89 - 0·95 mm. The body is oval in outline, with the thoracic epimera not pronounced and directed backwards. The first antenna has twelve distinct segments, the ninth having a stout spur (which is not hooked) on the anterior margin; the penultimate segment bears the usual large sensory filament and there is a series of thin delicate filaments inserted on each of the segments from the second to the ninth. The mouth parts show no specific characters except for the maxilla, the claw of which has a small seta

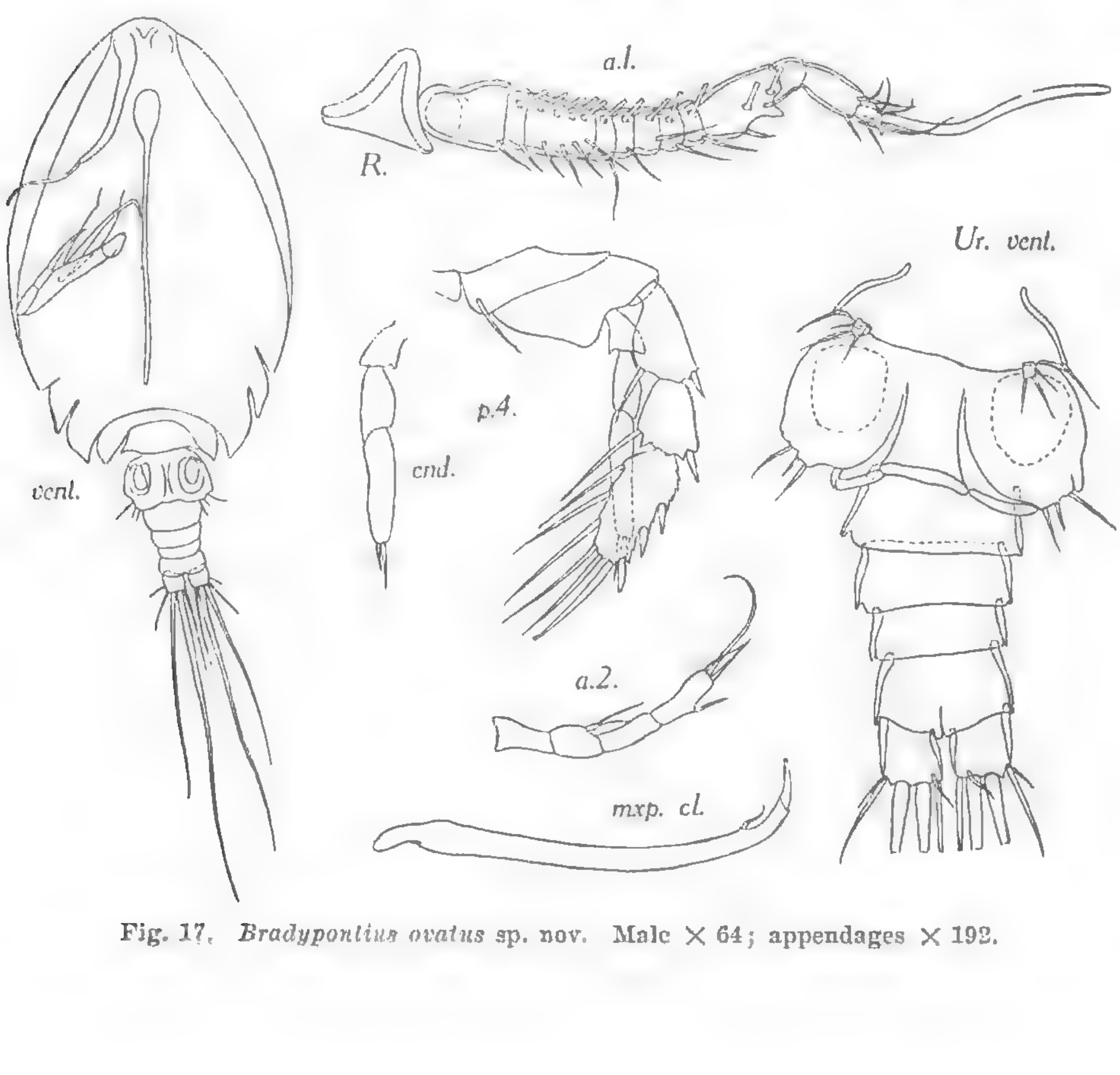

Fig. 17. *Bradypontius ovatus* sp. nov. Male × 64; appendages × 192.

near the end. The siphon extends to beyond the base of the second legs. The armature of the legs differs from that of *serratipes* only in having an inner seta on the basal segment of the first endopod. The fourth endopod is comparatively unarmed, like the other Mediterranean and Australian species, but differs from these in the proportions of the segments; the distal segment is as long as the first two together, and armed with two small terminal setae, these being the only setae on the ramus. The fifth legs are longer than wide, with two terminal and one outer marginal setae. The caudal rami are as long as wide and slightly shorter than the anal segment.

The species comes closest to *chelifer*, but differs in several respects, particularly in the armature of the fourth endopod.

It is of interest to note that all those species with reduced armature on the fourth endopod are either from the Mediterranean or from Australian waters, whereas all the others are from the colder regions of the northern or southern oceans and have fully armed fourth endopods.

Genus PTEROPONTIUS Giesbrecht.

Giesbrecht, 1895; 1899, pp. 91, 110.

According to Giesbrecht this genus is characterized by the postero-lateral projections from the thoracic and anterior urosome segments; the first thoracic segment is fused with the head, with a dorsal crest along its whole length; the second antenna is only three-segmented; the fourth leg is without an endopod; both rami of the first leg are two-segmented, with reduced setae; the distal segments of the third and fourth exopods have only two outer spines; and the fifth leg is knob-like. He described a single species, *cristatus* (1899, p. 36-8, pl. vii, fig. 24-39; x, fig. 15-17) and Brady (1910, p. 583, fig. lxvi) described a second, *scaber*; the species found here is distinct from both of these.

In the South Australian species the dorsal crest described for the head segment is continued along the second and third thoracic segments; the second antenna is only indistinctly three-segmented; the basipod of the fourth leg is composed of a single segment (as in *cristatus*. Giesbrecht, *op. cit.*, p. 37); and the exopods have three outer spines. It would appear that the segmentation of the fourth basipod may be a generic character while the armature of the third and fourth exopods is not of generic value. The very short, strongly built siphon appears also to be common to all three species of the genus.

As mentioned above, the genus is wrongly placed in Wilson's key (1932) but it is not surprising that minor errors have crept in when constructing keys of such magnitude as those prepared by Dr. Wilson.

Brady's description and figures for *scaber* are sufficient for the identification of his species as a member of the genus, which is well characterized by the lateral expansions of the thoracic and anterior urosome segments. His species differs notably in the shape of the body.

KEY TO THE FEMALES.

1.	Head segment wider than long	2.
	Head segment longer than wide	*scaber* Brady 1910.
2.	End segments of third and fourth exopods with two outer spines	*cristatus* Giesbrecht 1895.
	End segments of third and fourth exopods with three outer spines	*barbatus* sp. nov.

PTEROPONTIUS BARBATUS sp. nov.

Occurrence. IX, 1 female.

Female. Length 1·02 mm. The head segment is wider than long, with the rostral region slightly pronounced and having a small triangular rostrum

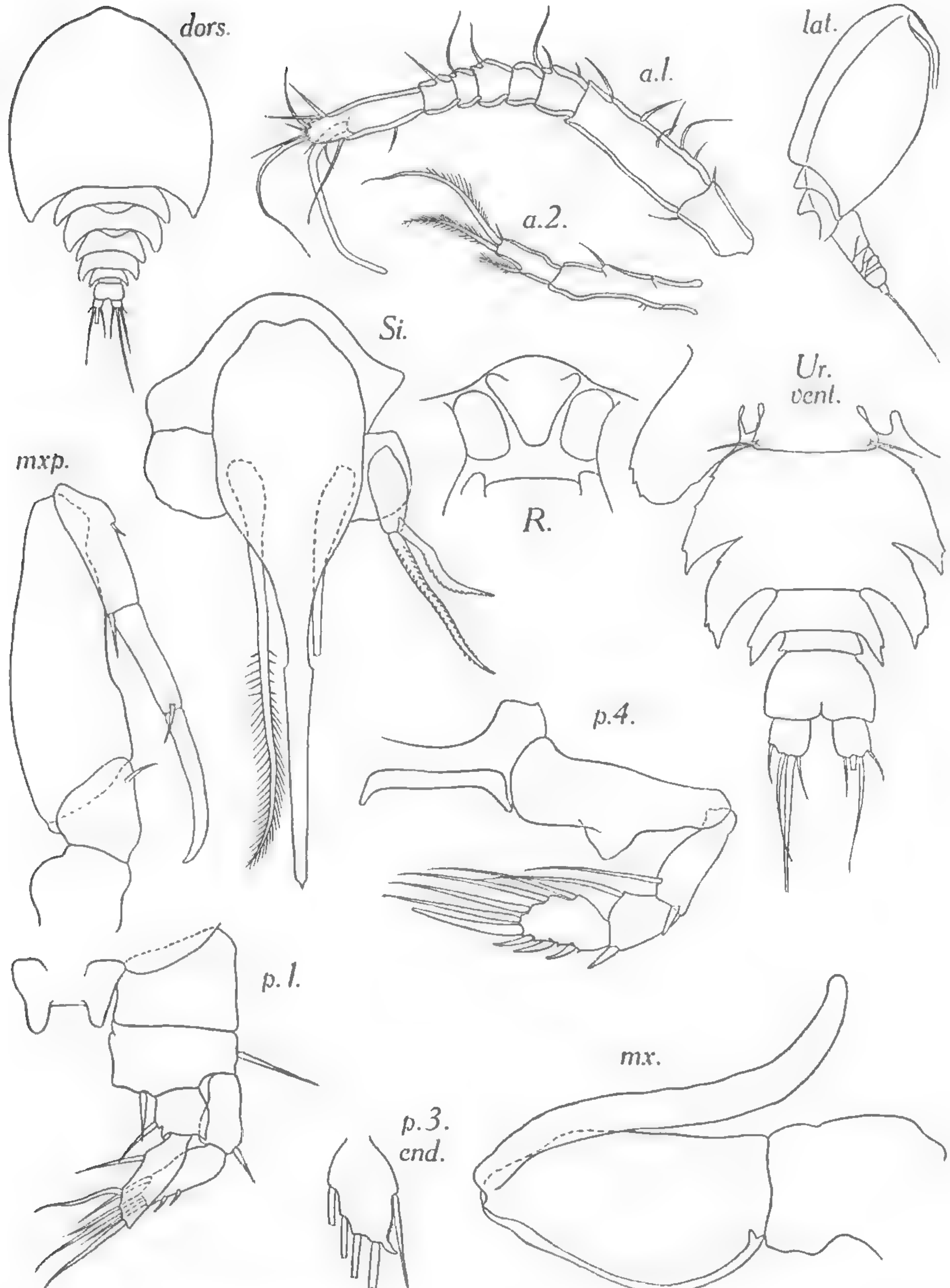

Fig. 18. *Pteropontius barbatus* sp. nov. Female × 38; rostrum and urosome × 144; appendages × 240.

ventrally; a well-developed dorsal crest runs along this and the two following segments which, together with the genital and second urosome segments, have well-developed epimeral plates with somewhat serrated edges. The genital segment

bears two such plates on each side. The first antenna is composed of eight distinct segments, the long second segment probably being composed of segments two to eight as in *cristatus*, but the fusion is so complete that it is difficult to make out the individual segments. The second antenna appears to be composed of only two segments but the basal segment is indistinctly and incompletely divided near the base, in a position comparable to that of *cristatus*. As in that species the end segment bears one small lateral and two longer unequal terminal setae, all plumose. The siphon is typical in being short and strongly built, with the distal portion little, if any, longer than the large base; it is distinct in having a pair of barb-like projections near the base of the tubular portion, hence the specific name. The maxillule is almost exactly as in *cristatus*, except that the shorter of the two spines on the outer lobe is sickle-shaped. The maxilla and maxilliped are of very strong construction, particularly the former, in which the basal segment is very powerful and the claw a long, strong, one-segmented structure distally curved and bluntly rounded terminally. The maxilliped is like that of *cristatus*, though more powerful.

The first pair of legs shows the typical two-segmented rami, with reduced setae; the second, third, and fourth exopods all have three outer spines on the end segment. The fourth endopod is absent but, as in *cristatus*, there is a large projection from the basal segment which is composed of the normal two segments (coxa and basis) completely fused. The seta formula for the legs is:

	endopod.	exopod.
p.1.	1.220.	0.122.
p.2.	1.2.321.	1.1.423.
p.3.	1.2.311.	1.1.423.
p.4.	—	1.1.323.

The end segment of the third endopod lacks the terminal spine and both second and third legs have the triangular prominence shown on the fourth basipod; this appears to correspond to the inner corner of the basipod of the first leg, somewhat displaced owing to the shape of the basipods in these legs. The fifth legs are reduced to minute rounded knobs bearing each a single seta.

The anal segment is dilated posteriorly and the caudal rami are about as wide as long and a little more than half of the anal segment. This species is of similar size to *cristatus* but much smaller than *scaber* (3·5 mm.). The male was not seen.

FAMILY ARTOTROGIDAE Sars.

Sars, 1915, p. 132.

The family was created by Sars for two genera, *Artotrogus* and *Dystrogus*, in which the body tends to be sub-circular and the fourth legs are absent. In the latter feature they approach the Cancerillidae, but those are distinguished from other Siphonostoma in having the second antenna modified into strong prehensile organs.

Artotrogus has hitherto been known only from the female (a male was found here), while *Dystrogus* is known only from the male.(3)

According to Giesbrecht (1899, pp. 110-111) they are distinguished by the siphon, which tapers to a more or lesss narrow tube in *Artotrogus*, while in *Dystrogus* it is of the same width throughout. The other characters quoted by

(3) Brady (1910, p. 583) described a species as *Dystrogus uncinatus* from a female. But this clearly has four pairs of legs, according to his statement, and cannot therefore belong to this family.

him are probably sexual, as in the difference in the genital segment, or only of specific value, as in the armature of the swimming legs and shape of the fifth leg. Probably of generic value is the shape of the body; in *Artotrogus* it is always sub-circular, with the urosome scarcely, if at all, projecting beyond the epimeral plates of the thorax; in *Dystrogus* the body is ovoid and the posterior segments of the urosome project well beyond the thoracic epimera.

Sars *(op. cit.*, p. 134) suggests that the shape of the female of *Dystrogus* when known may prove to resemble that of *Artotrogus*, implying that the difference in shape is sexual. This is not borne out by the male of *Artotrogus* found here, which is sub-circular like the female, whereas if Sars' implication were correct it might be expected more to resemble *Dystrogus* in shape.

Genus ARTOTROGUS Boeck.

Boeck, 1859; Giesbrecht, 1899, pp. 92, 111; Sars, 1915, p. 132.

It would appear that G. M. Thomson followed Brady (1880, p. 59), who quite unjustifiably regarded *Asterocheres, Ascomyzon* and *Artotrogus* as synonymous. Brady's chief reason for choosing the latter name for the genus was that it was "less objectionable" than *Asterocheres* and has priority over *Ascomyzon*. Whereas the two former are synonymous, *Artotrogus* is distinct. Giesbrecht (1899, p. 118) includes a list of synonyms and disposes of those species wrongly assigned to this genus up to the time when he wrote. The following species have since been added: *brevicaudatus* Brady, 1899; *gigas* and *sphaericus* Brady, 1910; *proximus* T. Scott, 1912; and *australis* Wilson, 1923.

Of the first of these Brady *(loc. cit.* p. 49) states that "The mouth organs and swimming feet present no distinctive characters" from which we can only assume that in these features the species agrees with Brady's diagnosis for the genus given in 1880 (p. 59). Here it is evident that he has overlooked the absence of the fourth leg in Boeck's species *orbicularis*, which is a true *Artotrogus*. We must, therefore, assume that *brevicaudatus* has a normal fourth leg, with three-segmented rami. From the figure of the whole animal (pl. xiii, fig. 22), showing well developed epimera, and that of the urosome (fig. 26) showing the genital segment widened anteriorly, it is clearly a member of the Dyspontiidae. Beyond this one cannot go with any degree of certainty, for while it would appear to be either *Cribropontius* or *Sestropontius*, the shape of the body is much more like that of *Cryptopontius*. The structure and size of the siphon also indicate this genus as does the claw of the maxilla, but inclusion in this genus requires that the fourth endopod should be absent. It is clear, however, that it does not belong to the Artotrogidae.

It is difficult to determine whether Brady's species *gigas* and *sphaericus* belong to *Artotrogus* or not. In spite of the pronounced sub-circular outline of the body, I am inclined to doubt that they should be included. It is clear that *sphaericus* is a female, and *gigas* must be presumed to be so, since the genital segment does not show the distinctive male characters. The latter species is inadequately described and figured, but in both this and *sphaericus* the urosome is too long, has too many segments, and the genital segment lacks the distinctive postero-lateral extensions found in *orbicularis* and *australis*. Further, in *sphaericus* the maxilla has the distal portion of the end claw distinct, and the whole claw is only slightly curved distally, whereas in *orbicularis* it is strongly curved and undivided. In both *orbicularis* and *australis* the siphon reaches the base of the maxillipeds, whereas in Brady's species it does not, but this may be of only minor importance. Brady's species *Dystrogus uncinatus* might have been accepted as an *Artotrogus*, but for his statement concerning the fourth legs, which excludes it from both this genus and from *Dystrogus*.

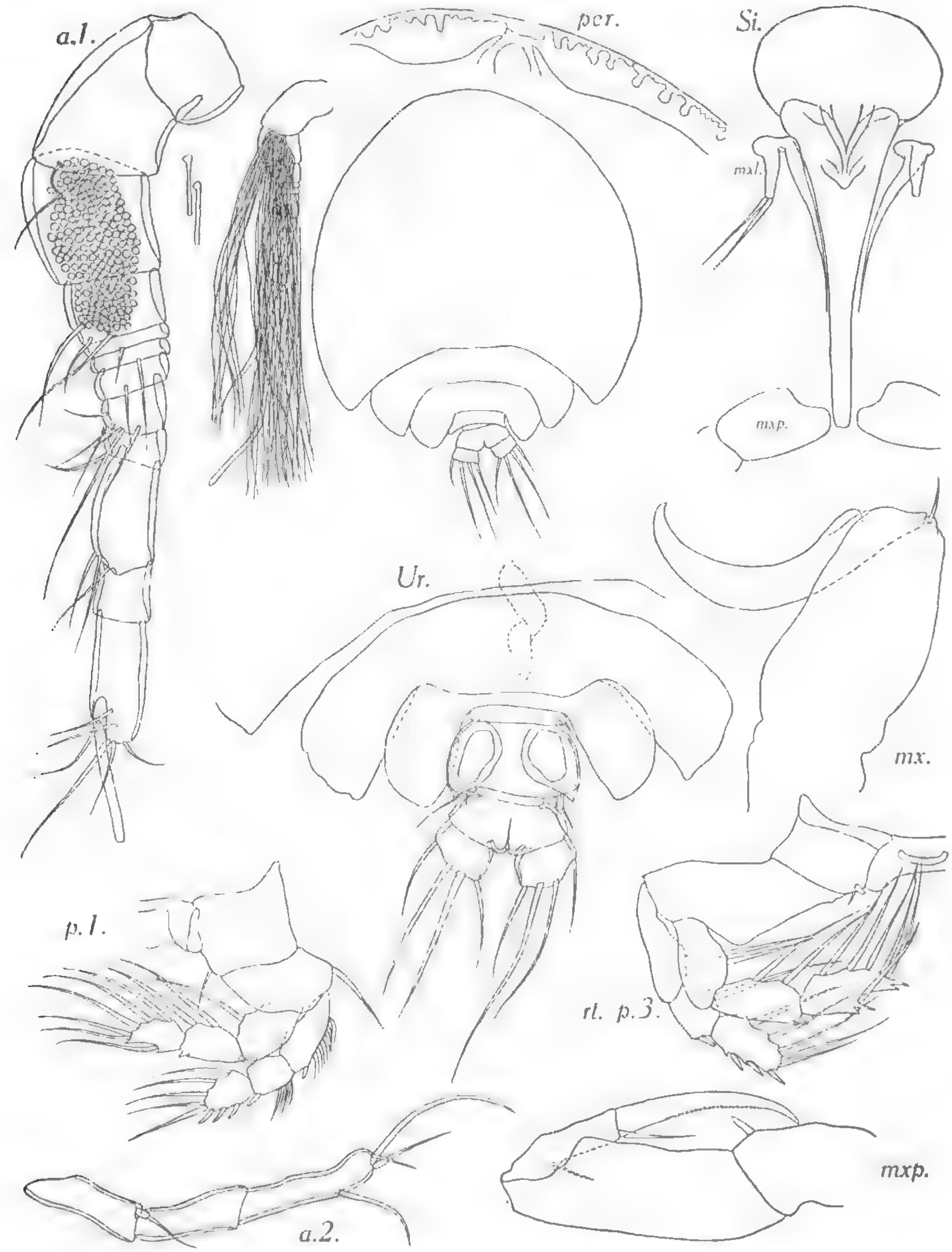

Fig. 19. *Artotrogus latifurcatus* sp. nov. Male × 35; urosome × 73; first and second antennae × 218; other figures × 131. The first antenna is shown also on a smaller scale (× 73) to illustrate the relative length of the sensory filaments, only 40 out of the total of 150 of which are shown. The bases of two of the filaments which have become detached are also shown (× 218). *per.* is portion of the anterior edge of the body seen from below (× 73).

Scott's species *proximus* must also be excluded from this genus on account of the well-developed fourth legs. It is difficult to place this species, which has certain affinities with *Bradypontius,* yet departs from that genus in several particulars. It is clearly a Dyspontiid.

Thus only two species are left: *orbicularis,* the type, and *australis* Wilson (1923). The latter was not fully illustrated since only a single specimen was obtained. According to Wilson it is distinguished from the type by "differences in the structural details of the two pairs of antennae, the first maxillae and the siphon" in addition to which it is twice the size of Boeck's species.

The species found here, a single male, is considerably smaller than Boeck's species, and is distinct from both his and Wilson's.

ARTOTROGUS LATIFURCATUS sp. nov.

Occurrence. XII, 1 male.

Male. Length, 1·37 mm.; width 1·24 mm. The body is sub-circular in outline with the caudal rami projecting beyond the posterior body margin. The urosome is composed of only three segments, the middle one of which is very short and narrower than either first or third. The third and fourth thoracic segments are fused, while the fifth is distinct but very short and without epimeral expansions; it bears a seta on each side representing the fifth legs. The genital segment is wider than long with two setae on each side of the hinder margin. The anal segment widens posteriorly to a greater extent even than in *australis.* The caudal rami are wider than long and bear only terminal setae.

The first antenna is composed of eleven segments, the fourth and fifth segments are very short, the sixth to eighth somewhat longer but shorter than any of the remaining segments. A large sensory filament is borne on the terminal segment and a great number of thin but much longer filaments are clustered together on the second and third segments. The position of these is indicated in the figure, but it was difficult to be certain of the total number. It was estimated that there were about one hundred on the second segment and fifty on the third. These filaments easily become detached, when it is found that they are swollen basally as shown in the figure. The second antenna is three-segmented, with the first two segments sub-equal and the third somewhat longer. A small exopod is borne distally on the basal segment and is armed with a single seta. The siphon is short but reaches to the base of the maxillipeds as in the other species. It is bluntly rounded as in *orbicularis.* The maxillule, maxilla and maxilliped are much as in the type species. The swimming legs have the following seta formula:

	endopod.	exopod.
p.1.	1.2.321.	1.1.323.
p.2.	1.2.321.	1.1.423.
p.3. right	1.2.321.	1.1.323.
p.3. left	1.1.321.	1.1.423.

The outer margin of the head segment (fig. 19, *per.*) shows a design similar to that shown for *Entomolepis* by Brady (1899) and for *Lepeopsyllus* by Thompson and Scott (1903).

Apart from its much smaller size than either of the two described species this differs from *orbicularis* in the elongate second antenna and in the armature of the distal segment of the third endopod. It differs from *australis* in that the siphon does not extend beyond the base of the maxillipds. Other points of difference are probably only sexual.

POECILOSTOMA.

One of the chief distinguishing features of this group of Cyclopoids, according to Sars (1917, p. 142), is the absence of any structures representing the mandibles of other copepods. He discusses this point at some length and states that the most anterior oral appendage is the maxilla (maxillule) bearing a palp which has been erroneously taken for an independent limb by other authors who have described them as mandible and maxillule. He points further to the resemblance between what he terms the maxilla in the families Clausidiidae and Cyclopidae; in the latter the mandible is always present but often without a palp, whereas the maxillule (his maxilla) always has a palp and is of similar structure to that found in the Clausidiidae. He admits, however, that "in a few cases this exopodite may assume a somewhat maxilla-like appearance."

In this connection I find myself in complete disagreement with Sars, at least as far as the Clausidiidae is concerned. The few specimens of *Hemicyclops* found in this collection have been dissected with particular attention as to whether these two anterior pairs of mouth parts came away together or were attached separately. In each case I found no attachment between them and during dissection observed that they were independently mounted side by side on the supporting skeleton. I am, therefore, convinced that there are two separate appendages: the mandible, which has the typical shape of such an appendage though lacking a palp and having a somewhat specialized armature and the maxillule, which is here distinctly cleft, the smaller lobe armed with strong spines representing the gnathobase, the larger lobe with setae only being the palp. Sars, in support of his view that there is only one appendage, the maxillule, states that "the said limbs are not placed, like the mandibles, at the side of that aperture (the mouth), but decidedly behind it, turning their extremities more or less forwards, precisely as do the maxillae in other Copepoda." While this may be true for the other Poecilostomous copepods, it obviously does not apply to the Clausidiidae, as can be seen at once by an examination of Sars' figures for the oral area in both *Hemicyclops purpureus* and *Hippomolgus furcifer* (pl. lxxxi, lxxxii). My own figure for the oral area of *Hemicyclops australis* (fig. 21), described below, agrees closely in the arrangement of the parts with those given by Sars, as does also the figure of *Goidelia* given by Embleton (1901, pl. 22, fig. 10). Sars' figures differ from those of Embleton and myself only in having the maxillule attached to the base of the mandible.

As mentioned above, Sars admits the "maxilla-like appearance" of what he regards as the "palp or exopodite" of "the foremost pair of limbs" and points out its resemblance to that appendage in some of the Cyclopidae. The best answer to this is supplied by Sars himself in his figure for *Hippomolgus furcifer* (pl. lxxxii, *m*). Here, according to his interpretation, we see a maxillule with a palp attached basally. In the Cyclopidae (cf. Sars, pl. xii-xvi, xliii, xlviii, and l) the palp is always attached to the *distal* portion of this appendage.

Gurney (1927, p. 464) has discussed this question and concludes that "neither the structure nor the position of these appendages is inconsistent with their interpretation as mandibles." While I share the hesitation expressed by Dr. Gurney in differing from "an authority of such eminence and accuracy as Prof. Sars," it would certainly appear that Sars has drawn the mandible and maxillule together as a single appendage. Even if these two appendages were really parts of the same appendage it would seem more reasonable to interpret that appendage as the mandible, with a proximally inserted palp, as has been done by Wilson (1932a) and Light and Hartman (1937). As Embleton (*loc. cit.*) has shown in *Goidelia* it is the maxillule which has undergone the greatest reduction.

Wilson (1932a, pl. 5 C) figures a mandible, with palp, for *Hemicyclops americanus*, though he does not mention such an appendage in the text (p. 45); here he describes the "first maxilla" from which it is apparent that he is referring to the structure labelled "mandible" in the plate. For *H. thysanotus*, Wilson (1935) describes a mandible (p. 784) and figures its palp (fig. 44), without reference to the maxillule. For *H. callianassae*, described in the same paper, no reference is made to these mouth parts. It is to be assumed, however, that Wilson interprets as mandible and palp what Sars regarded as maxillule and palp.

Light and Hartman (1937) have figured the "mandible" of *H. pugettensis* with the "palp removed" (p. 177, fig. 17) and in the text (p. 181) they describe the "palp" but make no mention of a maxillule; this is in conformity with their statement (p. 180) that "The genus *Hemicyclops* is characterized by the presence of a well-developed mandibular palp," and yet, in their description (p. 176) of *Clausidium vancouverense* (Haddon, 1912) both mandible and maxillule are recognized and described. From their descriptions it is clear that these appendages have a structure similar to those of other members of the family and are correctly interpreted as mandible and maxillule.

Leigh-Sharpe (1939) in his re-description of *Hersiliodes pelseneeri* Canu regards the mandible and maxillule as separate appendages and describes the maxillule as biramous, which is in conformity with the view already expressed by Gurney and upheld here.

Thus it may be asserted that the Clausidiidae depart from Sars' definition of the Poecilostoma in that a distinct mandible is present. But Gurney (*loc. cit.*) goes further, and states that in other Poecilostomous cyclopoids, even in the Lichomolgidae, the mandible and its "palp" are separable and can be recognized as distinct appendages. His figure of *Thersitina gasterostei* (Gurney, 1913, pl. xi, fig. C) shows an arrangement of mouth parts similar to that given below for *Hemicyclops*.

This view is supported by the figure of the oral region of *Paranthessius propinquus* sp. nov. given below (fig. 24), in which although the mandible and maxillule could not clearly be traced back to their points of attachment, there did not appear to be any obvious insertion of the maxillule on the mandible as a "palp".

FAMILY CLAUSIDIIDAE Embleton.

Embleton, 1901.

Originally named the Hersiliidae Canu (1888) it was first shown by Embleton (1901) that *Hersilia* (Phil. 1839) had been twice preoccupied. Kossmann (1874) had described a species of *Hersilia* under the name *Clausidium* and Embleton therefore substituted Kossmann's name for Philippi's and established the family under Kossmann's name.

There would not appear to be any justification for the introduction of a new name for *Hersilia* by Strand (1914), who proposed to replace it by *Pseudohersilia*, which name therefore becomes a synonym of *Clausidium*. Sars (1917, p. 145) has shown that *Platycheiron* T. and A. Scott (1892) is a synonym of *Hemicyclops*. As will be shown below the genus *Saphirella* T. Scott (1894) representing, as already pointed out by several authors, the immature stage of a Clausidiid, is a synonym of *Hemicyclops*. *Goidelia* Embleton (1901) was placed in this family, but it is with considerable doubt that I have included it, differing as it does in several important features, particularly the prehensile second antenna.

In view of the difference of opinion regarding the interpretation of the mouth parts, and with the inclusion of *Goidelia*, it will be necessary here to give a new diagnosis of the family.

First thoracic segment fused with the cephalon; urosome 4- or 5-segmented in the female; 5-segmented in the male. First antenna 5- to 7-segmented. Second antenna usually armed only with setae. Labrum short and broad, fringed with fine spinules. Mandible reduced, without a palp and armed always with one terminal claw with or without accessory pieces which are never more than three in number. Maxillule bilobed, the smaller inner lobe armed with spines, the outer lobe with setae only or reduced to a single lobe armed only with setae. Maxilla short and stout, 2-segmented, the proximal segment armed with simple spines, the distal segment with two strong claw-like spines. Maxillipeds reduced and scarcely prehensile in the female but well-developed and strongly prehensile in the male. Swimming legs usually of normal structure, though showing a peculiar modification of the first pair in *Clausidium*. Fifth legs lamellar, one- to three-segmented. The following genera are included:

HEMICYCLOPS Boeck.

Hemicyclops Boeck, 1873.
nec *Hemicyclops* Claus, 1893.
Platycheiron T. and A. Scott, 1892.
Saphirella T. Scott, 1894.
Saphirella Wolfenden, 1905.
Hemicyclops Sars, 1917.
Saphirella Sewell, 1924.
Hemicyclops Light and Hartman, 1937.

CLAUSIDIUM Kossmann.

Binoculus Say, 1818.
Hersilia Philippi, 1839.
Clausidium Kossmann, 1874.
Clausidium Embleton, 1901.
Clausidium Light and Hartman, 1937.

HERSILIODES Canu.

Hersiliodes Canu, 1888.
Hersiliodes Bourne, 1890.
Hersiliodes Thompson and Scott, 1903 (pro parte).

H. dubia Thompson and Scott (1903) is clearly a *Hippomolgus*, the only male so far described for this genus.

GIARDELLA Canu.

Giardella Canu, 1888.
Giardella A. Scott, 1906.

GOIDELIA Embleton.

Goidelia Embleton, 1901.

HIPPOMOLGUS Sars.

Hersiliodes Thompson and Scott, 1903 (pro parte).
Hippomolgus Sars, 1917.

KEY TO THE GENERA.

1.	First legs modified into sucking organs	*Clausidium* Kossmann 1874.
	First legs normally developed	2.
2.	Second antenna prehensile, armed with claws; fifth legs three-segmented	*Goidelia* Embleton 1901.
	Second antenna non-prehensile, armed only with setae; fifth legs one- or two-segmented ..	3.
3.	Fifth leg one-segmented	4.
	Fifth leg two-segmented	5.
4.	First antenna short and compact	*Hippomolgus* Sars 1917.
	First antenna long and slender	*Hersiliodes* Canu 1888.
5.	Mandible armed with one claw and two hooks	*Giardella* Canu 1888.
	Mandible armed with one claw, one toothed plate, and two setae	*Hemicyclops* Boeck 1873.

Genus HEMICYCLOPS Boeck.

Sars, 1917, p. 145; Light and Hartman, 1937.

A key to the species of this genus has been given by Light and Hartman, who have discussed the genus and give reasons for excluding the two species *Hersiliodes*

puffini Thompson 1887, and *H. thompsoni* Canu 1888, which Sars (1917, p. 145) considered should be transferred to *Hemicyclops*. *H. elongatus* Wilson (1937) was described in the same year as Light and Hartman's review and so was not included in their key.

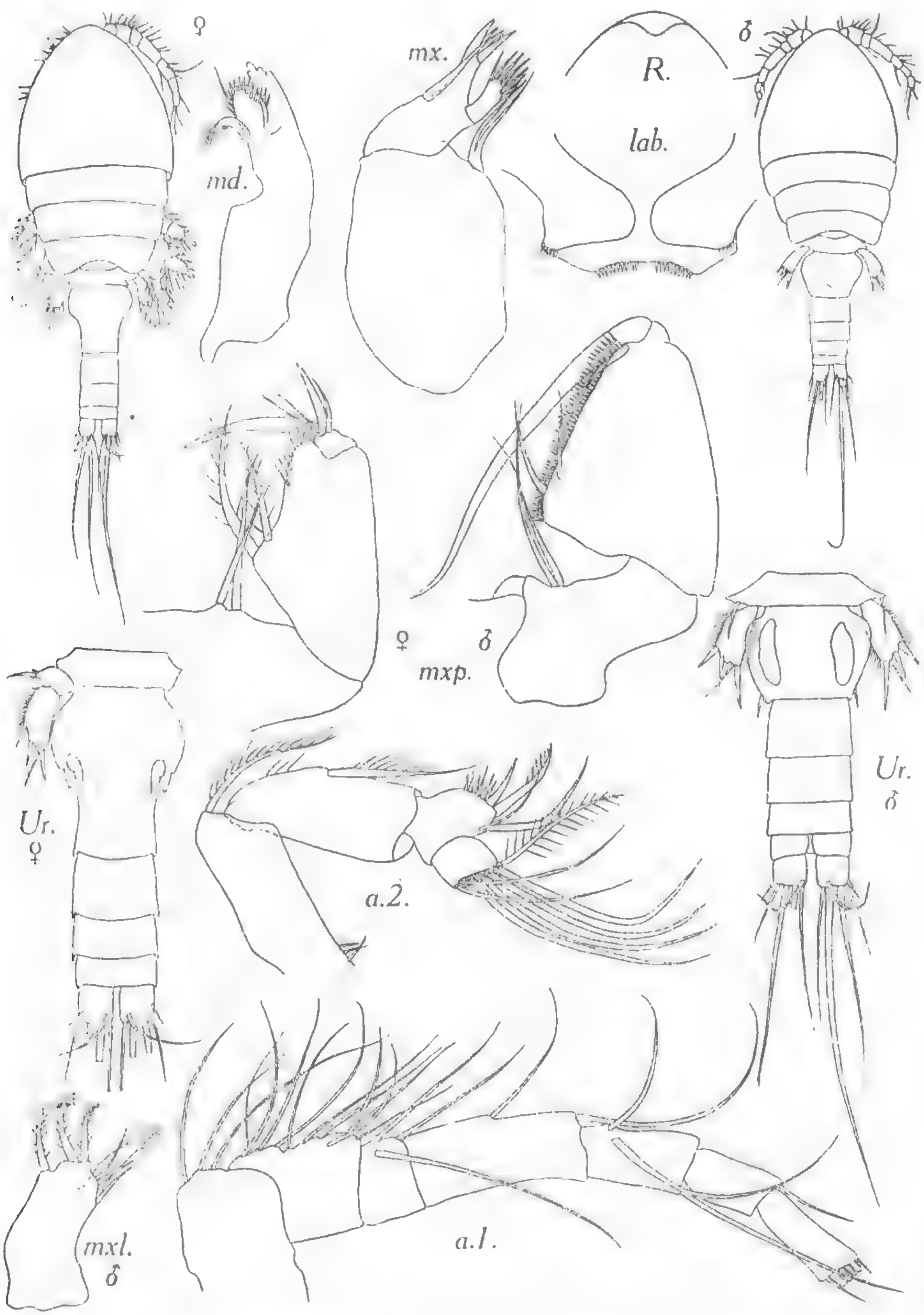

Fig. 20. *Hemicyclops australis* sp. nov. Male and female × 38; rostrum, and urosome, both sexes, × 80; appendages × 240.

HEMICYCLOPS AUSTRALIS sp. nov.

Occurrence. IX, 1 female, 1 male; XI, 2 females, 1 male.

Female. Length 1·38 - 1·40 mm. The body has the usual shape and proportions found in the genus; the genital segment is swollen and rounded anteriorly with lateral projections behind the swollen portion, and is longer than the rest

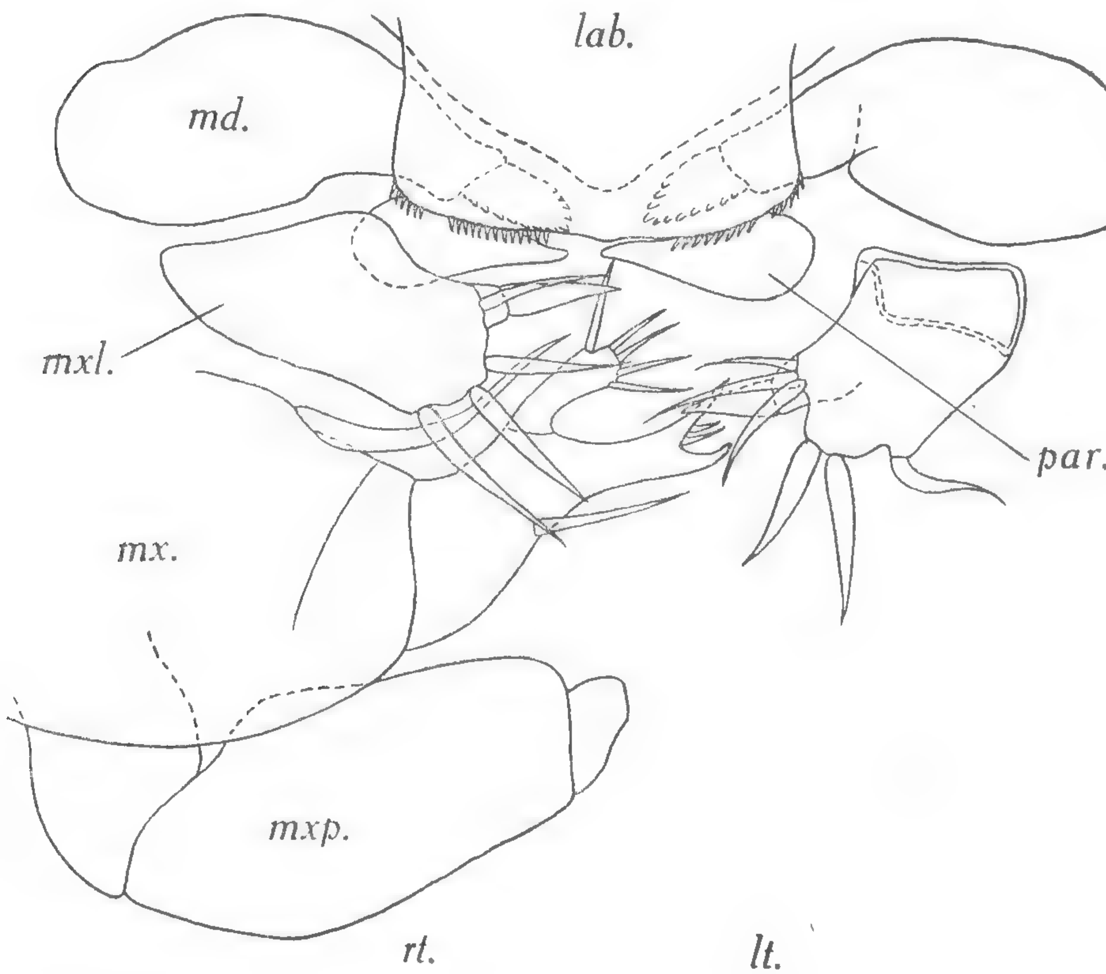

Fig. 21. *Hemicyclops australis* sp. nov., oral area seen from below × 450. In the process of dissection the left maxilla and maxilliped were removed, and the maxillule slightly displaced posteriorly from its natural position. On this side the base of this appendage and its position of attachment are clearly seen. On the right side the appendages occupy their normal positions. It is of interest to note that paragnaths (*par.*) are present and that the mandible and maxillule are distinct appendages.

of the urosome; the anal segment is the shortest; the caudal rami are sub-rectangular, almost as wide as long and longer than the anal segment. The first antenna is 7-segmented; the second antenna has the two proximal segments long and sub-equal, the third segment is short and has a lateral swelling, and the terminal segment is short and sub-rectangular, wider than long. The upper lip is of a distinctive shape and armed with marginal spines; the mandible is armed with a large terminal toothed "claw," a wide lamellar toothed plate and two setae, one of which is strongly built, the other much more slender; the maxillule is clearly bilobed, the inner lobe bearing a strong spine and three setae, the outer armed only with setae; the maxilla is two-segmented, the basal segment bears a long double

spine distally and the end segment has a large terminal claw and accessory seta, and a small inner branch armed with spines. The maxilliped is three-segmented, the basal segment armed with two long setae, the second with an inner projection or bulge bearing two spinous setae, and the terminal segment bears two unequal claws and some setae. The swimming legs are of the usual structure with the following seta formula:

	endopod.	exopod.
p.1.	1.1.51.	0.1.62.
p.2.	1.2.33.	0.1.54.
p.3.	1.2.24.	0.1.54.
p.4.	1.2.14.	0.1.53.

The setae and spines are arranged in a more or less continuous series around the margins of the distal segments of these legs so that it is difficult to decide how many are terminal and where the inner and outer begin or end. No attempt has been made to express the distribution of the setae on the end segments in the formula, the figures refer to the number of setae and spines respectively. On the end segment of the third exopod the figures given are 54, but on the other leg of that pair there were five setae, but only three spines. The fifth leg is two-segmented, the basal segment armed with a short seta and the distal segment with one spine and one seta terminally and two outer lateral spines.

Male. Length 1·17 - 1·20 mm. The body is like that of the female, but the urosome is five-segmented. At the postero-distal corners of the genital segment there is a spine representing the sixth legs. The only appendage showing any difference from the female is the maxilliped which, as usual in this group, is much more strongly prehensile than that of the female. The terminal claw is much longer and more strongly developed and the whole of the inner edge of the middle segment is armed with a series of short stout spines; this segment is roughly triangular in shape due to the greater development of the inner prominence found also in the female. The seta formula for the swimming legs is like that of the female.

This species resembles *callianassae* Wilson (1935) and *purpureus* Boeck (Sars, 1917) in having the genital segment undivided, though in the former this segment is no longer than the preceding segments. It further resembles *purpureus* in the comparatively short caudal rami. It is distinguished from this species, however, by the structure of the second antennae in which it resembles *pugettensis* Light and Hartman (1937) and *thysanotus* Wilson (1935) in having the third segment swollen and laterally produced, though without the distal extension found in these species and so noticeable in *thysanotus*.

Further, in the proportional lengths of the third and fourth segments of the second antenna, when compared with the second segment, it resembles *aberdonensis* T. and A. Scott (1892), and with this species is distinguished from others in the genus by this feature. It differs from *elongatus* in the genital segment and caudal rami, which are four times as long as wide in the latter. (The second antennae have not been described for *elongatus* Wilson (1937)).

"SAPHIRELLA" and "PAUROCOPE"

It appears to be a characteristic feature of the members of the Clausidiidae that some of the mouth parts show very little, if any, alteration during the post-larval development. Canu (*fide* Embleton, *op. cit.*, p. 219) found that the mouth parts are not altered by the various moults, and Embleton states for *Goidelia japonica* that "The form of the mandible . . . is constant for the adult and immature stages of both sexes" and that the maxillules are "alike in all stages and both sexes." In *Goidelia*, unlike the other members of the family, both the maxilla

and maxilliped are strongly developed and show sexual differences. The maxilla in the female and maxilliped in the male are specialized for prehension and alter during development, and conversely, the maxilla in the male and maxilliped in the female are less developed and show little or no change in development.

In attempting to place the genera *Saphirella* and *Paurocope,* therefore, one would expect to find the clue to their adult forms in the mandibles and maxillules.

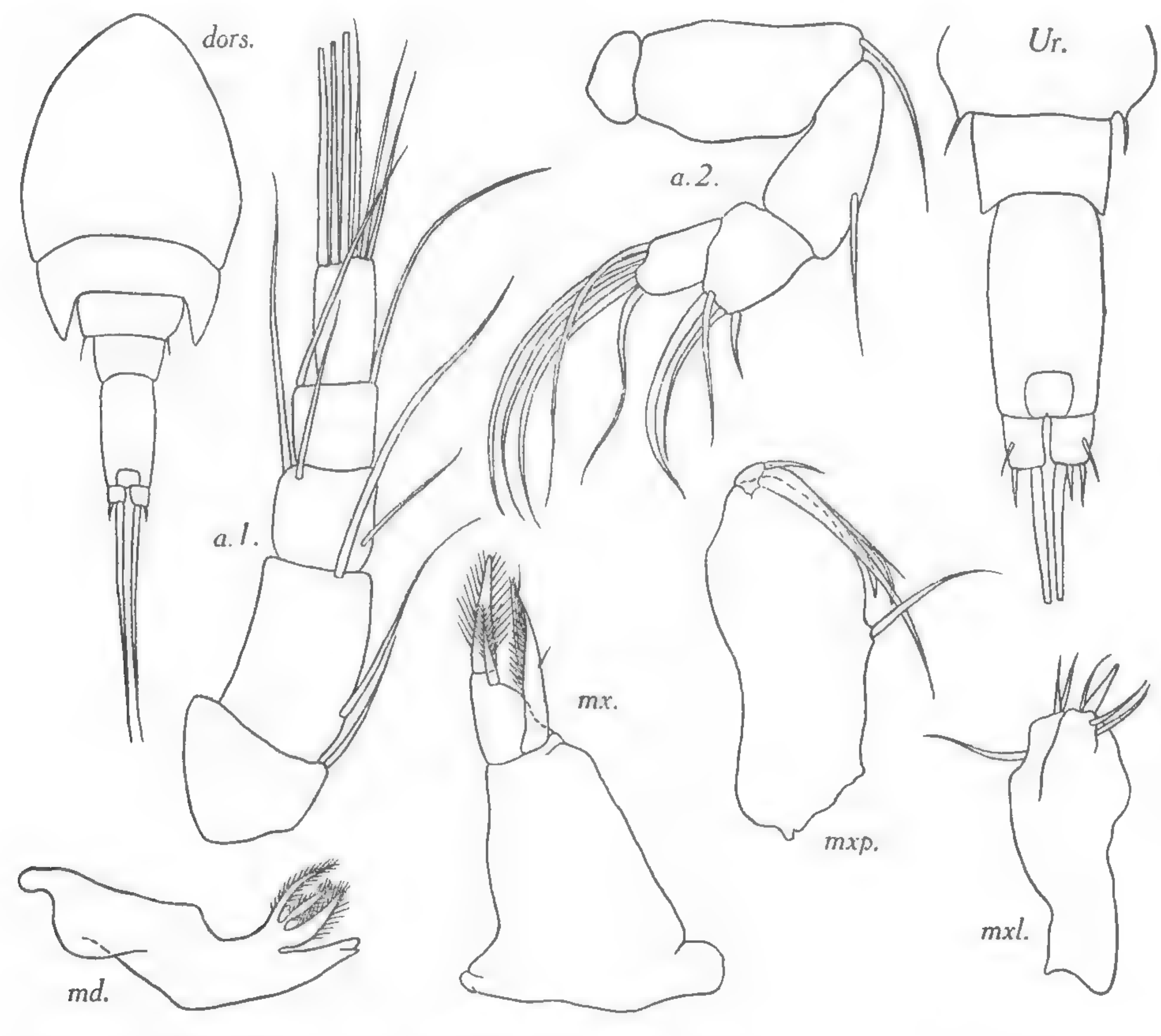

Fig. 22. *"Saphirella" tropica* Wolfenden = *Hemicyclops* sp., juvenile. Dorsal view × 48; urosome × 100; appendages × 300.

In studying the plankton collected by the C. S. and I. R. Fishery Research vessel "Warreen" I have encountered a single specimen of a copepod apparently referable to *Saphirella* and most closely resembling Wolfenden's species *tropica.* I am indebted to Dr. H. Thompson, Chief of the Division of Fisheries, for permission to include a description of this specimen here. As can be seen from a comparison of the respective figures for *"Saphirella tropica"* and *Hemicyclops australis,* described above, the mandible and maxillule show the same structure. The terminal claw of the mandible is more nodular in the adult and the toothed plate more robust. In the maxillule both parts and all the armature found in the adult are represented in the immature form. Unfortunately, this appendage was mounted so that the two lobes overlap one another in the immature form, but the corresponding parts can clearly be made out. The maxilla and maxilliped are not so fully developed as in the adult, but from the structure of the latter appendage

in the immature form it would appear that the specimen was a female. One of the more striking features of this immature specimen is the structure of the second antenna, which clearly shows the lateral expansion of the third segment so characteristic of several species of *Hemicyclops*. The first antenna shows only five segments instead of the full number of seven.

Before definitely identifying *Saphirella* with *Hemicyclops* it should be noted that two other genera have a mandible similarly armed. Embleton *(op. cit.*, p. 214, 215) quoting Canu, shows that in *Hersiliodes* there are three accessory parts to the mandible in addition to the terminal claw, and Sars (1917, pl. lxxxii) shows a similar structure for the mandible of *Hippomolgus*. In the former, in addition to the claw and blade, there are "two long bearded flexible hooks" or "setae," whereas in *Hemicyclops* and *Hippomolgus* these two setae are short, no longer than the claw and blade. In the latter genus the maxilliped and its armature are greatly reduced in the female though strongly prehensile in the male (cf. *H. dubia* (Thompson and Scott) 1903, pl. iii, fig. 24) in conformity with the characters of the family. It is clear, therefore, that in *Saphirella* we have the young form of *Hemicyclops*.

Concerning *Paurocope* Brady (1899), Sewell (1924, p. 800) attempts to show that it may be synonymous with *Saphirella*, but I cannot entirely agree with his interpretation of Brady's figures.

We know that in one genus *(Goidelia)* the mandible may be armed with a single terminal claw. Brady's fig. 5 (pl. xiii) may truly represent the mandible as claimed by him. His fig. 6, which he calls the maxilla (maxillule) is certainly not that appendage but might be either the terminal portion of the maxilla or, more likely, the end of the mandible showing the terminal claw with three accessory pieces (in this case two toothed blades and one seta) typical of three out of the six known genera. His fig. 7 is unrelatable to any other recognizable mouth part, though the terminal portion might represent the maxillule as suggested by Sewell (*loc. cit.*) The proximal portion bears no relationship to any of the mouth parts known for this family. It seems probable to me, therefore, that *Paurocope* does represent a distinct genus, and since I cannot relate it to any of the known genera I regard it as representing the immature stage of a seventh member of the Clausidiidae, the adult of which is so far unknown. This view gains some support from a comparison of the published figures of the whole animal in dorsal view. Compare T. Scott, 1894, pl. xiii, fig. 57; Wolfenden, 1905, pl. xcix, fig. 12; T. Scott, 1921, pl. iv, fig. 2; Sewell, 1924, pl. lix, fig 1; and the figure given here. In every case the first free thoracic segment shows strong lateral posterior projections, reaching at least half-way to the hinder margin of the following segment in *indica* and right to the posterior margin of that segment in every other case. Compare these with *Paurocope* and it will be seen that Brady shows very little, if any, posterior extension to this segment.

"SAPHIRELLA" TROPICA = HEMICYCLOPS sp.

Wolfenden, 1905, p. 1,030.

Occurrence. C.S.I.R. Station 204/39, 24/7/39, 50-0 Vertical net, 32° 18′ S., 152° 24′ E.

Distribution. Indian Ocean.

Immature specimen. Length 1·06 mm. This copepod has already been discussed above; a detailed description of the mouth parts would merely be repetitive of what has already been said for *Hemicyclops australis*. Only two pairs of legs were present, each with one-segmented rami, a third pair was represented by spines only. The figure is included here (fig. 22) so that comparison can be made with previous descriptions and with the species of *Hemicyclops*.

FAMILY LICHOMOLGIDAE Claus.

Claus, 1889, p. 328; Sars, 1917, p. 149; Gurney, 1927, p. 463.

Claus associated a number of similar genera under this heading; Sars defined the family and added further genera and later authors hav since contributed additional genera. Gurney has suggested that the group should be divided into two sub-families according to the segmentation of the fourth endopod.

SUB-FAMILY SABELLIPHILINAE Gurney.

Gurney, 1927, p. 463.

Lichomolgidae in which the fourth endopod is three-segmented. One genus is represented in this collection.

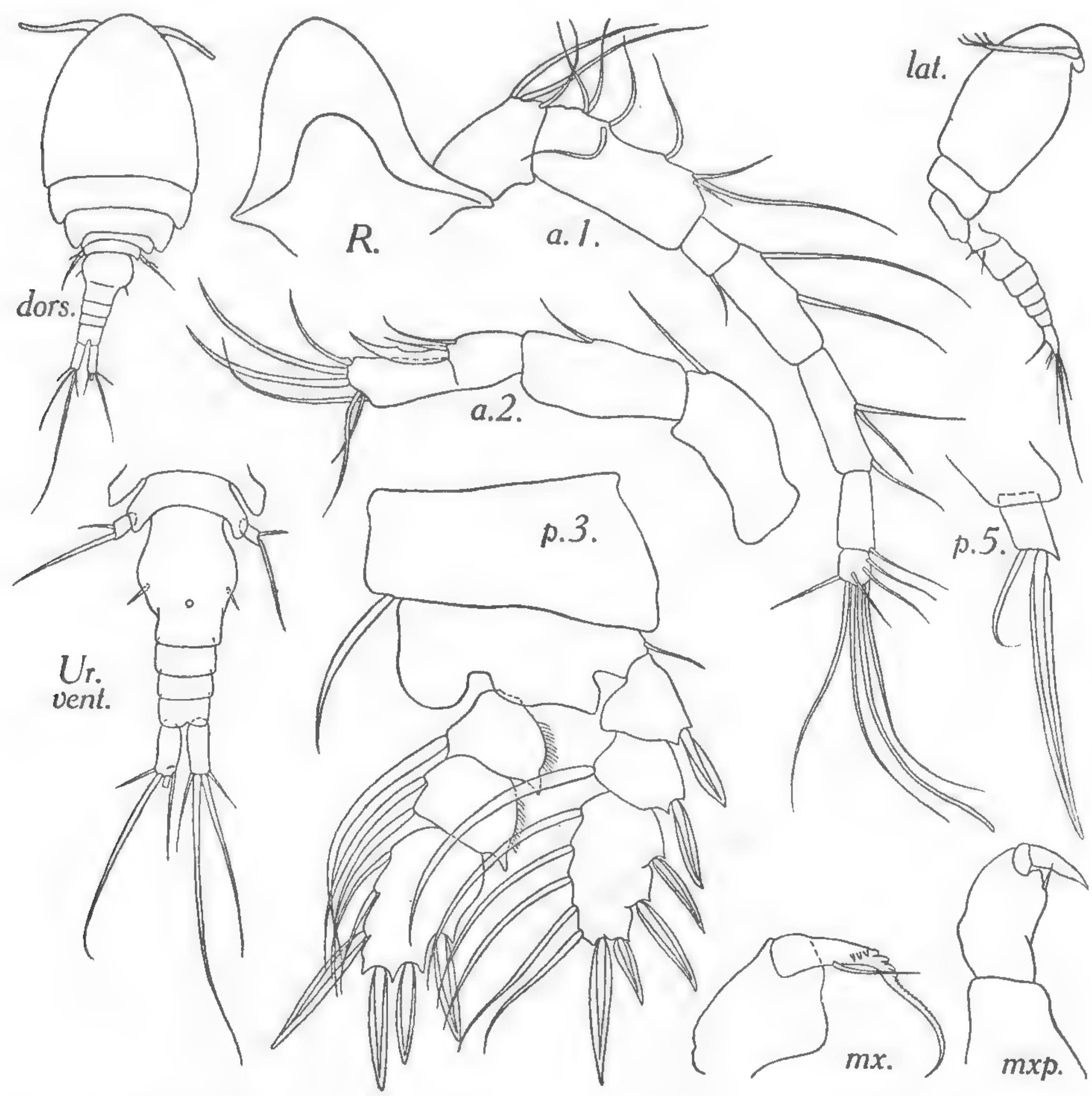

Fig. 23. *Paranthessius propinquus* sp. nov. Female × 38; urosome × 80; appendages × 240.

Genus PARANTHESSIUS Claus.

Claus, 1889; Monod and Dollfus, 1932, p. 143.

Monod and Dollfus (*loc. cit.*) state that *Herrmannella* Canu (1891) is synonymous with this genus. While I am not entirely in agreement with them, I am not sufficiently familiar with the group to question their conclusion, and have contented myself with comparing the species found here with all those species which have been identified as belonging to either of these genera (with the exception of *H. rostrata* Canu 1891, *H. cynthiae* Brian 1924, and *Heteranthessius dubius* (T. Scott) 1903, and *Pestalichomolgus pectinis* (Pesta) 1908, the two latter also being included in *Paranthessius* by these authors, since the literature in each case has not been available to me).

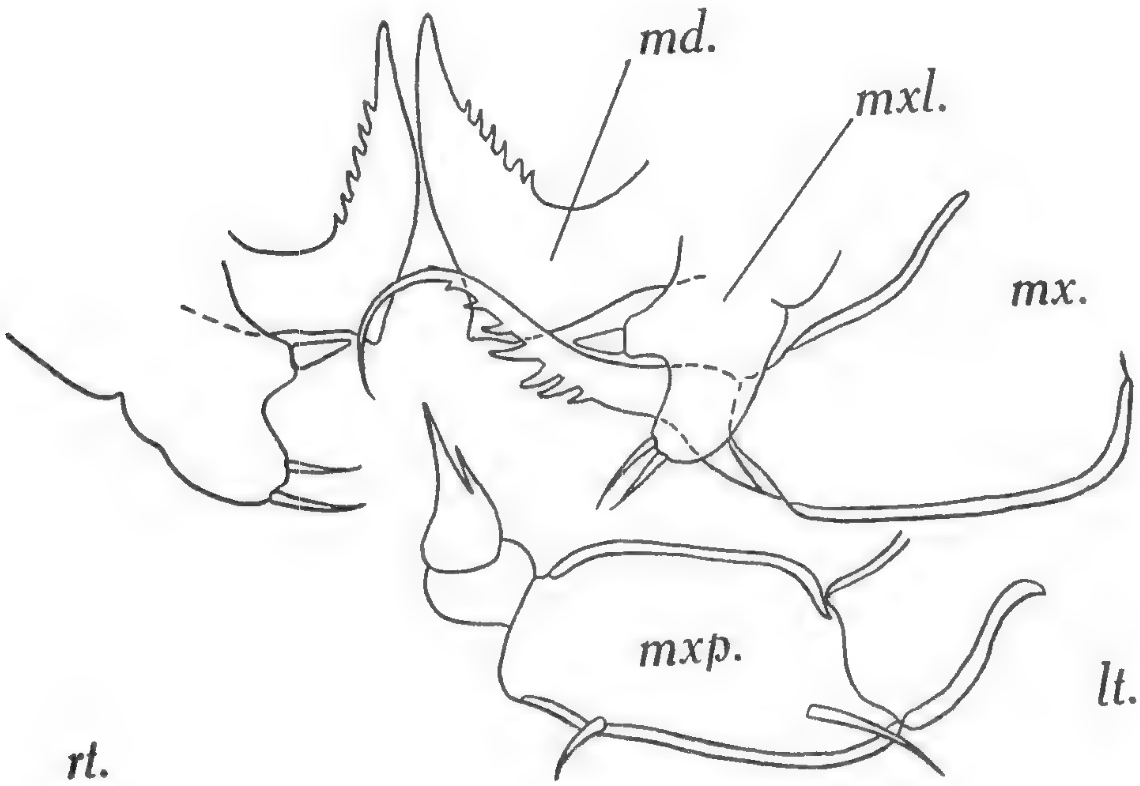

Fig. 24. *Paranthessius propinquus* sp. nov. Mouth parts *in situ* seen from below. (× 565).

The species found here would appear, with these reservations, to be distinct, and I have therefore described it as a new species.

PARANTHESSIUS PROPINQUUS sp. nov.

Occurrence. IX, 2 females.

Female. Length 1·02 – 1·06 mm. The body is of the usual shape in this genus, with a well-developed rostrum ventrally. The urosome is composed of four segments, the genital segment comprising half the urosome, including the caudal rami. These are about two and one-half times as long as wide, and as long as the anal and pre-anal segments together. The first antenna is 7-segmented and of the usual form; the second antenna consists of four segments, the first two large and sub-equal, each with a single lateral seta, the third segment is short and bears a distal curved spine and two setae, and the end segment bears six terminal

setae. The mouth parts are normal; the mandible and maxillule were lost in the first dissection but are shown in the figure of the oral region. In the seta formula for the legs the distribution around the terminal segments is not shown, but the figures indicate the total number of setae and spines respectively on these segments:

	endopod.	exopod.
p.1.	1.1.51.	0.1.44.
p.2.	1.2.33.	0.1.54.
p.3.	1.1.24.	0.1.54.
p.4.	1.1.14.	0.1.53.

The fifth leg consists of a single segment, half as long again as wide, with its inner distal corner produced into a pointed process and armed terminally with one long, bladed spine and a shorter seta.

SUB-FAMILY LICHOMOLGINAE Gurney.

This group contains those genera in which the fourth endopod is reduced to two or fewer segments, sometimes being absent.

Genus PSEUDANTHESSIUS Claus.

Claus, 1889, p. 344; Sars, 1917, p. 166.

The synonymy of this genus has been discussed by Gurney (1927, p. 463) and by Monod and Dollfus (1932, p. 139). It need only be added that *P. fucicolus* T. Scott (1912) should be transferred to Gurney's genus *Kelleria*, which he established (1927, p. 470) for "certain species in which the endopod of leg 4 is one-jointed, but with an inner seta and a notch in the position of the joint in *Lichomolgus*, and with a freely movable 5th leg" (*op. cit.*, p. 463). The following species remain in this genus: *liber and thorelli* (Brady and Robertson) 1875; *gracilis* Claus 1889; *sauvagei* Canu 1891; *concinnus* Thompson and Scott 1903; *obscurus* and *weberi* A. Scott 1909; *assimilis* Sars 1917; *dubius* Sars 1918; *mucronatus* Gurney 1927; *nemertophilus* Gallien 1935.

The species found here can be identified with none of these and so must constitute a new species.

KEY TO THE SPECIES.

1. Outer margin of the fourth endopod entire .. .. 2.
   Outer margin of the fourth endopod broken by a swelling or indentation which may become a conspicuous knob or notch .. .. 3.
2. Caudal rami twice as long as wide, little longer than the anal segment *liber* (Brady and Robertson) 1875.
   Caudal rami three times as long as wide, one-third as long again as the anal segment *assimilis* Sars 1917.
3. Caudal rami twice as long as wide .. .. .. *sauvagei* Canu 1891.
   Caudal rami more than twice but not more than four times as long as wide .. .. 4.
   Caudal rami more than four times but not more than six times as long as wide .. 6.
   Caudal rami at least ten times as long as wide .. .. 7.
4. Fourth endopod with marked notch at proximal third; segments of first antenna short and compact; genital segment not greatly dilated .. .. *obscurus* A. Scott 1909.
   Fourth endopod with notch or constriction at centre; segments of first antenna normal; genital segment considerably dilated .. .. 5.
5. Second thoracic segment with posterior projections; fourth endopod no longer than basal segment of exopod, with proximal bulge but no notch .. *mucronatus* Gurney 1927.
   Second thoracic segment without posterior projections; fourth endopod longer than basal segment of exopod and with a distinct notch .. .. *tenuis* sp. nov.

6. Fourth endopod with marked notch at about centre; caudal rami six times as long as wide .. *gracilis* Claus 1889.
Fourth endopod with slight notch at centre and proximal bulge; caudal rami five times as long as wide .. .. *weberi* A. Scott 1909.
Fourth endopod without notch, but with slight proximal bulge; caudal rami four to four-and-one-half times as long as wide .. .. *nemertophilus* Gallien 1935.
7. Last two segments of urosome subequal .. .. 8.
Anal segment at least twice as long as pre-anal .. *thorelli* (Brady and Robertson) 1875.
8. Caudal rami about as long as last two segments of urosome together *dubius* Sars 1918.
Caudal rami about as long as last three segments of urosome together *concinnus* Thompson and Scott 1903.

PSEUDANTHESSIUS TENUIS sp. nov.

Occurrence. IX, 1 female.

Female. Length 0·66 mm. Body of usual shape in the genus, with the genital segment distinctly dilated anteriorly, bearing a pair of pointed postero-lateral

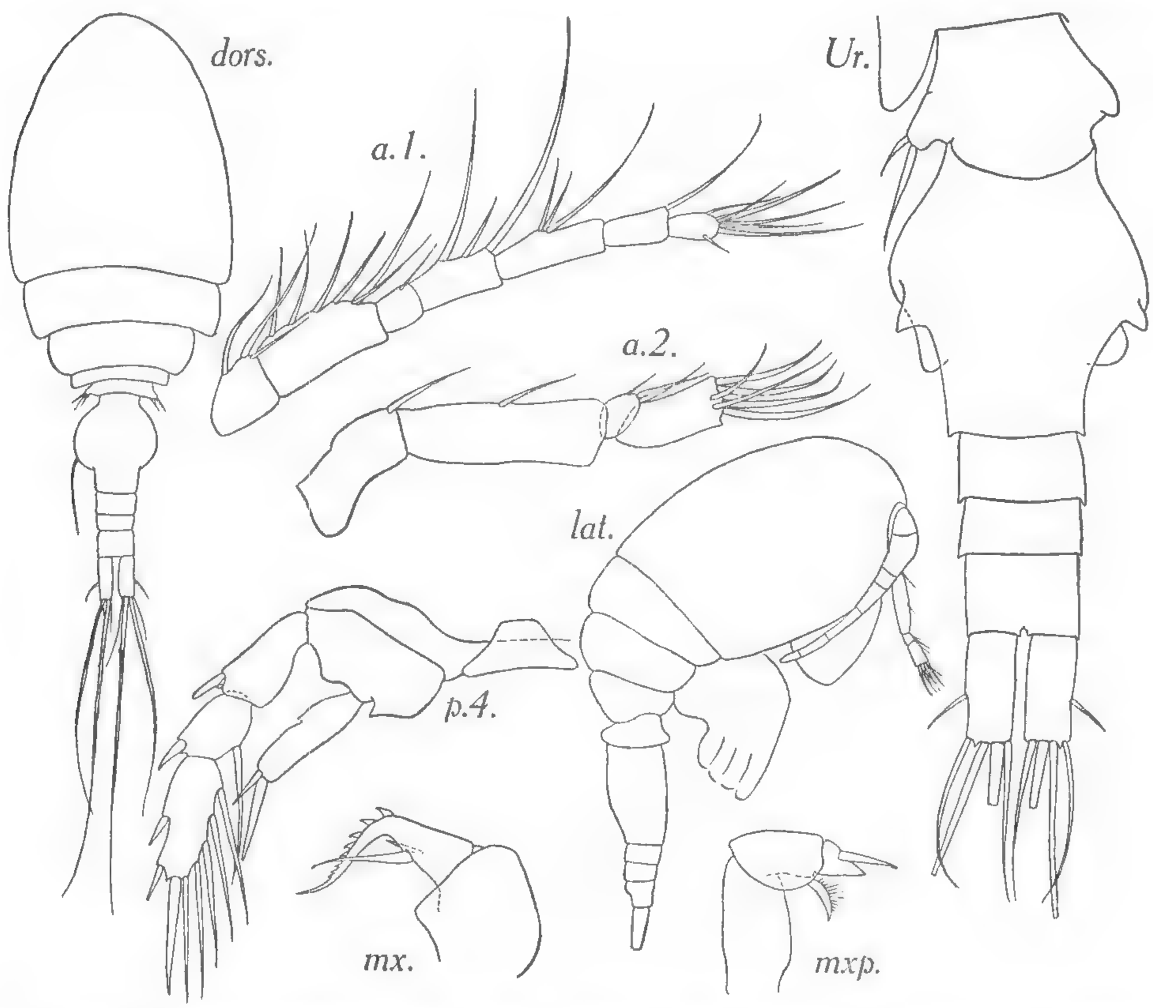

Fig. 25. *Pseudanthessius tenuis* sp. nov. Female × 80; urosome and appendages × 240.

projections dorsally at about the centre and a pair of rounded projections ventrally, just behind the dorsal projections. The anal segment is longer than the pre-anal, but not as long as the caudal rami, which are distinctly more than twice as long as wide. The first antenna is 7-segmented and of normal appearance; the

second antenna has an elongate second segment, a very short third segment and a moderately long end segment bearing four long spines and two setae. The mandible and maxillule were not seen; the maxilla and maxilliped resemble those of *gracilis* Claus as shown by Sars (1917, pl. xciii). The swimming legs have the following seta formula:

	endopod.	exopod.
p.1.	1.1.321.	0.1.323.
p.2.	1.2.321.	0.1.423.
p.3.	1.2.221.	0.1.423.
p.4.	020.	0.1.422.

The one-segmented fourth endopod has two unequal terminal spines; the fifth legs are immobile rounded knobs, tipped with two setae, typical for the genus.

Male unknown.

This species approaches most closely to Gurney's species *mucronatus*, from which it differs in a number of points: the body is more slender, the thorax is without hooks, and the fourth somite is distinct and not overlapped by the third; the genital segment is longer than wide, the caudal rami are not more than two-and-one-half times as long as wide and the terminal setae are distinctly longer than the urosome; the first antenna is nearly as long as the cephalosome; the third and fourth segments of the second antenna are quite unequal and the end segment bears four setiform claws; the endopod of the fourth leg is distinctly notched and the fifth leg bears only two setae.

MONSTRILLOIDA.

FAMILY MONSTRILLIDAE.

Genus MONSTRILLA Dana 1848

Sars, 1921a, p. 10.

There are some twenty-one species of *Monstrilla* which have been described; of these I have been unable to compare this species with the descriptions of *canadensis* McMurrich 1917, *conjunctiva* Giesbrecht 1902, *intermedia* Aurivillius 1898, *longispinosa* Bourne 1890, *ostroumowi* Karaviev 1895, and *wandelii* Stephensen 1913. It appears in the structure of the fifth leg to approach most closely to *mixta* T. Scott 1914, but differs in having only two setae instead of three here, and further, in the much shorter length of the setiform appendage on the genital segment and in the first antenna; the shape of the cephalic segment is also different. Scott compares his form with Giesbrecht's *conjunctiva*, described from a male, but this is one of those species with which I have been unable to make any comparison. The probability is that it is an undescribed species, but with so many descriptions unavailable I hesitate to name this as a new species.

MONSTRILLA sp.

Occurrence. III, 2 females (1 damaged); length 3·38 mm.

NOTODELPHYOIDA.

Sars divides this sub-order into seven families, the last of which is the monotypic Anomopsyllidae. This family is included in the sub-order only provisionally by Sars, owing to the extraordinary reduction of the appendages. Its chief affinities with the Notodelphyoida lie in the manner in which the eggs are carried in a dorsal brood pouch. The single member of this sub-order found in this collection would appear to belong to this family, but it is quite distinct from the only

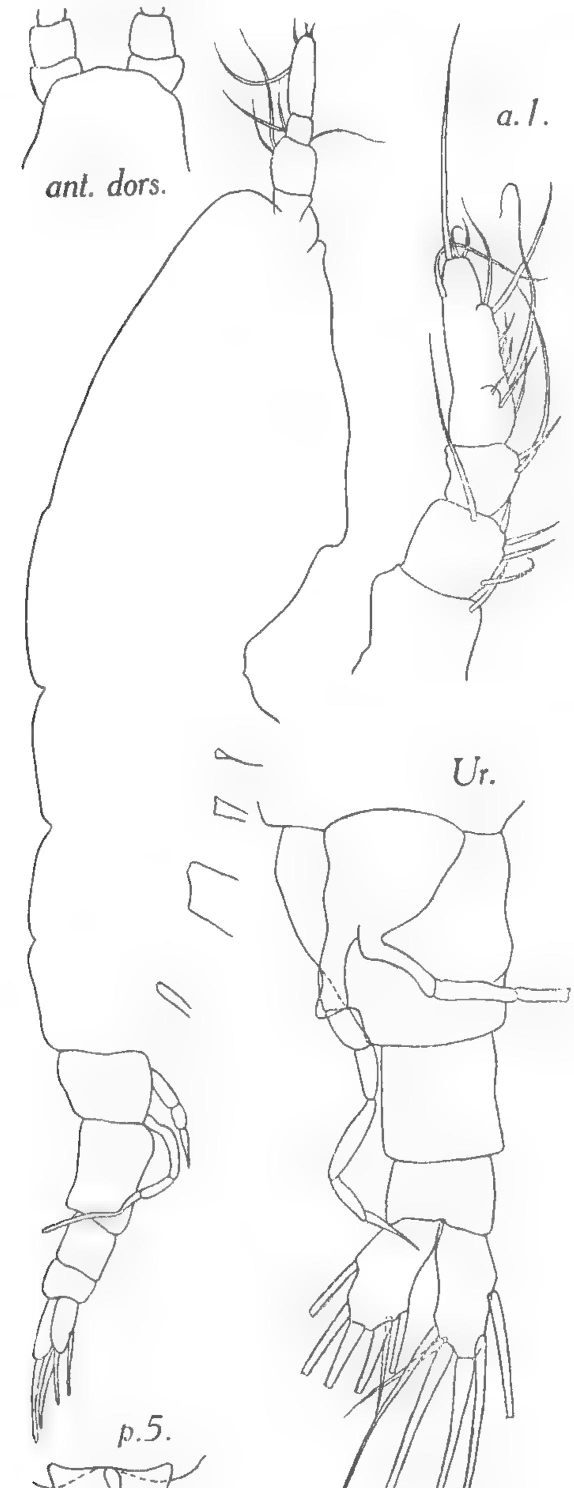

Fig. 26. *Monstrilla* sp., female. Side view and head × 35; urosome and appendages × 73.

genus so far described, *Anomopsyllus*. The reduction in the appendages found in this genus is carried almost to an extreme in the specimen found here, which is a mature female with eggs.

FAMILY ANOMOPSYLLIDAE Sars.

Sars, 1921a, p. 81.

No separate family diagnosis was given by Sars, since only the one species, *Anomopsyllus pranizoides*, was known and the family could only have the charac-

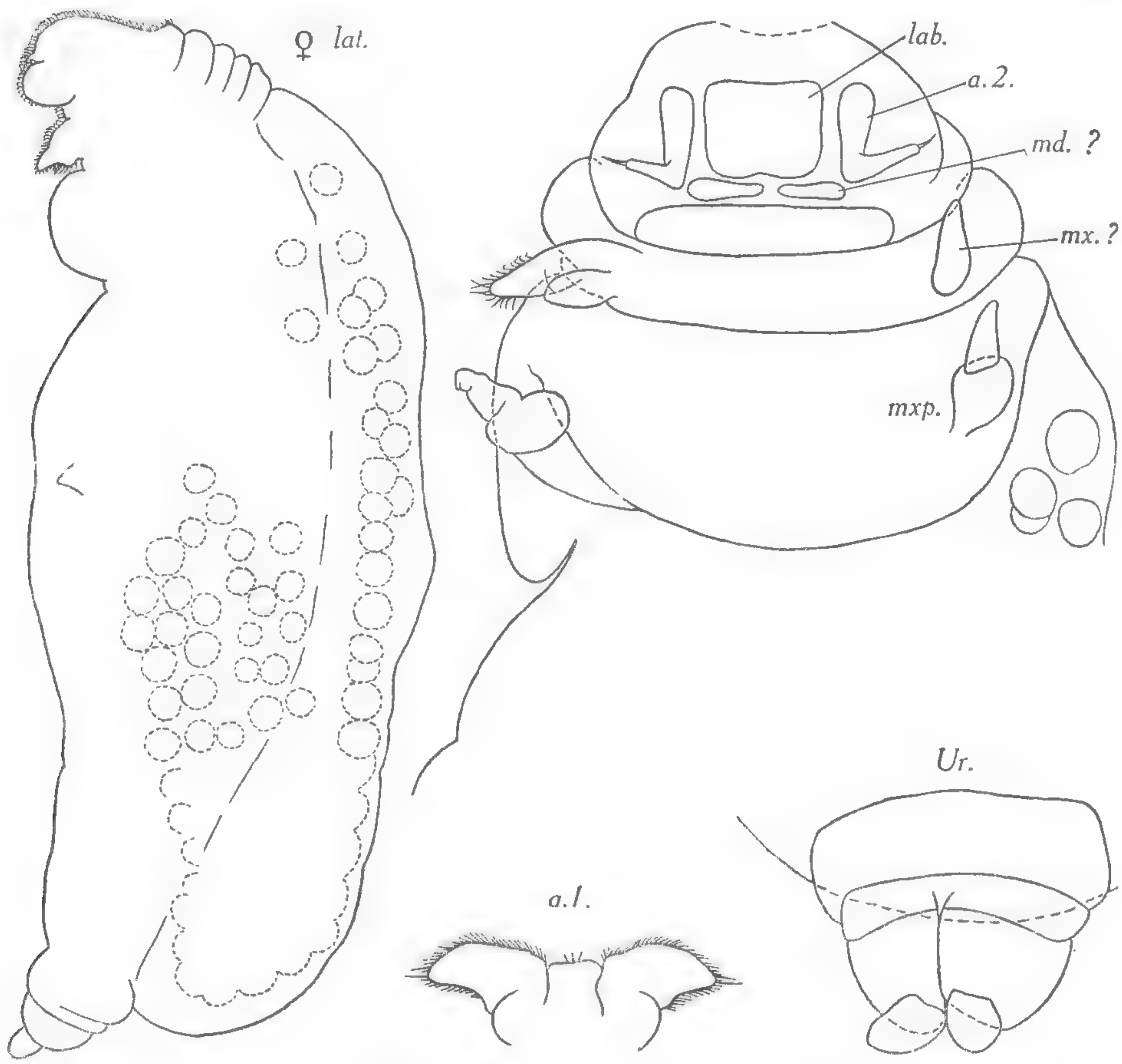

Fig. 27. *Dysgenopsyllus reevesbyensis* gen. et sp. nov. Female × 48; other figures × 100.

ters of the genus. An attempt is made here to define the family, based on characters common to both genera. The males are unknown.

Body divided into three regions, more or less sharply defined; the trunk composes most of the body and is unsegmented, the head is a small anterior region and the urosome a narrow two- or three-segmented posterior portion. The head appendages are greatly reduced, though some of the anterior ones may be segmented; the legs are reduced to small unsegmented triangular processes, quite unarmed. Caudal rami are present, but their armature may be reduced.

DYSGENOPSYLLUS REEVESBYENSIS gen. et sp. nov.

Occurrence. XV, 1 female.

Female. Length 2·35 mm. The body has the characters of the family. The first antenna is reduced to an unsegmented process fringed with fine hairs. The second antenna is two-segmented and armed with a single, terminal, slightly clawed spine; this is the most fully developed appendage on the body. There appears to be a large plate-like upper lip, with a pair of mandibles lying just behind it; maxillules could not be identified. The maxilla and maxilliped appear as segmented processes armed only with fine hairs. One pair of legs is present as small triangular processes like those of *Anomopsyllus*. The urosome is three-segmented, with the middle segment very short; the caudal rami are lobular unarmed processes.

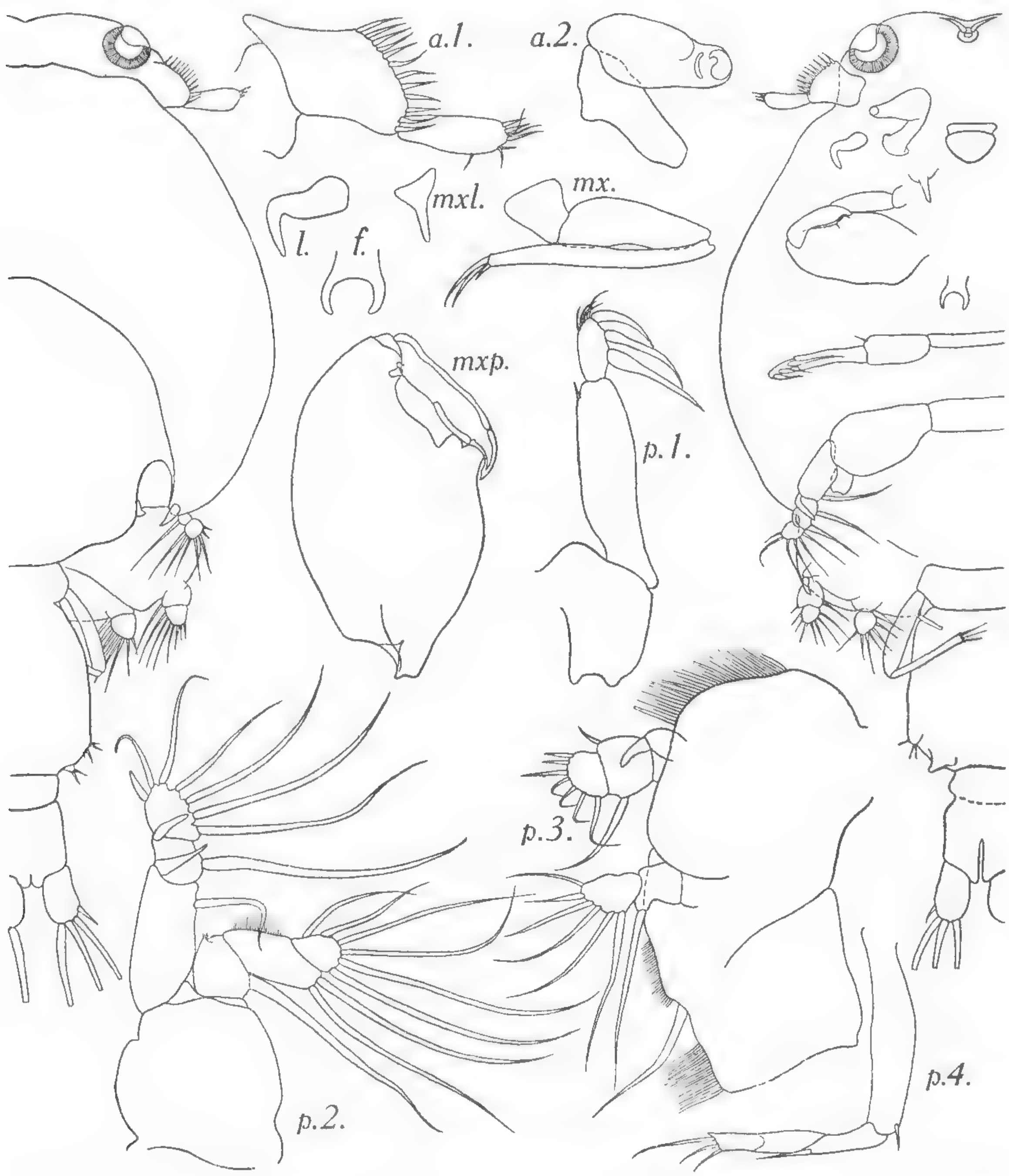

Fig. 28. *Caligus* sp., male. Dorsal and ventral views × 38; appendages × 80. *f.*, furca; *l.*, lateral hook.

This very inadequate description summarizes all that could be made out from the single specimen available. Apart from the removal of the first antennae the specimen has not been dissected.

The generic name, for the suggestion of which I am indebted to Professor G. Wood, of the Department of Classics and Ancient History at this University, is intended to indicate the degenerate condition of this animal.

CALIGOIDA.

Family CALIGIDAE.

Caligus sp.

Occurrence. XVI, 1 male, 2·83 mm.

So much of the literature required for the identification of this species is not available to me that I have made no attempt to identify it beyond comparing it with the species included in Wilson's (1905) key to the genus. From this it would appear to approach most closely to *teres* Wilson (1905), but it is certainly not identical with that species. I have given full illustrations of the specimen found here in the hope that others more familiar with the group will be able to identify it.

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List of Samples and Contents.

I. Smith Bay, Kangaroo Island; 15/3/38.

Calanopia thompsoni A. Scott.

II. Western Shoal, Spencer Gulf; 20/2/38.

Calanopia thompsoni A. Scott.
Tortanus barbatus (Brady).
Labidocera cervi Kramer.
Longipedia australica Nicholls.
Peltidium speciosum Thompson and Scott.

III. Blanche Harbour, Spencer Gulf; 8/3/38.

Acrocalanus gracilis Giesbrecht.
Pseudophaenna sp.?
Gladioferens inermis sp. nov.
Pseudodiaptomus cornutus sp. nov.
Calanopia thompsoni A. Scott.
Tortanus barbatus (Brady).
Longipedia coronata Claus.
Tegastes sp.
Oithona nana Giesbrecht.
O. attenuata Farran.
Monstrilla sp.

IV. Wallaroo Harbour, Spencer Gulf; 26/2/38.

Calanopia thompsoni A. Scott.
Labidocera cervi Kramer.
Parapeltidium dubium Nicholls.

V. Eastern Shoal, Spencer Gulf; 4/3/38.

Calanopia thompsoni A. Scott.
Labidocera cervi Kramer.
L. caudata sp. nov.
Tortanus barbatus (Brady).

VI. Salt Lake, Beachport.

Brunella salina sp. nov.

VII. Moonta Bay, Spencer Gulf; February, 1939.

Calanopia thompsoni A. Scott.
Peltidium proximum Nicholls.
P. speciosum Thomp. and Scott.
Parapeltidium cristatum Nicholls.
Amphiascopsis longipes Nicholls.
Laophonte cornuta Philippi.

VIII. Port Willunga; 17/1/37.

Parapeltidium cristatum Nicholls.

IX–XIII. Sellick Reef; 31/1/37–April, 1939.

Pseudocyclops australis sp. nov.
Calanopia thompsoni A. Scott.
Longipedia coronata Claus.
L. australica Nicholls.
Alteutha spinicauda Nicholls.
A. signata Brady.
Peltidium simplex Nicholls.
P. proximum Nicholls.
P. speciosum Thomp. and Scott.
Parapeltidium cristatum Nicholls.
Porcellidium fimbriatum Claus.
P. fulvum Thomson.
P. acuticaudatum Thomp. and Scott.
P. australe Brady.
Machairopus intermedius Nicholls.
Eudactylopus australis Nicholls.
Phyllothalestris mysis (Claus).
Amphiascopsis longipes Nicholls.
A. australis Nicholls.
Amphiascoides intermixtus (Willey).
Parialysus robustus (Nicholls).
Mesochra pygmaea (Claus).
Orthopsyllus rugosus Nicholls.
Laophonte cornuta Philippi.
L. longiseta Nicholls.
Ceyloniella armata (Claus).
Metis jousseaumei (Richard).

Australomyzon typicus gen. et sp. nov.
Scottocheres latus sp. nov.
Acontiophorus zealandicus sp. nov.
Myzopontius australis sp. nov.
Cryptopontius similis sp. nov.
C. latus sp. nov.
C. proximum sp. nov.
C. longipes sp. nov.
Discopontius discoides gen. et sp. nov.
Bradypontius inermis sp. nov.
B. serratipes sp. nov.
B. ovatus sp. nov.
Pteropontius barbatus sp. nov.
Artotrogus latifurcatus sp. nov.
Hemicyclops australis sp. nov.
Paranthessius propinquus sp. nov.
Pseudanthessius tenuis sp. nov.

XIV. Spencer Gulf, dredgings; March, 1938.

Calanopia thompsoni A. Scott.
Longipedia australica Nicholls.
Peltidium proximum Nicholls.
P. speciosum Thomp. and Scott.
Eudactylopus australis Nicholls.
Parialysus robustus (Nicholls).
Laophonte cornuta Philippi.
Caligus sp.

XV. Reevesby Island, Spencer Gulf; 7/12/36.

Dysgenopsyllus reevesbyensis gen. et sp. nov.

AUSTRALIAN CUMACEA. NO. 7[1]
THE GENUS CYCLASPIS

By Herbert M. Hale, Director, South Australian Museum

Summary

Until recently, little intensive collecting of Cumacea was carried out in the Pacific. A rather prolonged investigation of some areas off southern and eastern Australia makes it possible to state now that these crustaceans, while not so abundant as the Amphipoda, here constitute an important part of the bottom fauna. They are found in the stomachs of some of the Australian fishes but, excepting the more strongly calcified forms, are usually in such fragmentary condition that specific identification is not possible. In jars of sea water, Amphipoda collected at the same time as Cumacea have been observed feeding upon the latter, biting off the anterior part of the thorax and discarding the rest of the body with the spiny legs and uropods attached.

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Fig. 1-60.

INTRODUCTION.

Until recently, little intensive collecting of Cumacea was carried out in the Pacific. A rather prolonged investigation of some areas off southern and eastern Australia makes it possible to state now that these crustaceans, while not so abundant as the Amphipoda, here constitute an important part of the bottom fauna. They are found in the stomachs of some of the Australian fishes but, excepting the more strongly calcified forms, are usually in such fragmentary condition that specific identification is not possible. In jars of sea water, Amphipoda collected at the same time as Cumacea have been observed feeding upon the latter, biting off the anterior part of the thorax and discarding the rest of the body with the spiny legs and uropods attached.

I am particularly indebted to my colleague, Mr. Keith Sheard, for his very able help in securing the unusually large collection now available for study. Much of the material to be dealt with was taken by the Federal Research Vessel "Warreen" in waters off South Australia, Victoria, southern Queensland and, particularly, New South Wales. Dr. H. Thomson, Chief of the Fisheries Division of the Commonwealth Council for Scientific and Industrial Research, has co-operated whole-heartedly in encouraging and making possible this search for members of an order which, generally, is not accorded much attention.

Collecting methods which have proved most productive of results are (1) the use of formalin (Hale, 1936, p. 404); (2) the employment of a submerged light of low candlepower at night (Sheard, 1941, p. 12, and Hale, 1943, pp. 337, 338); (3) a "one man" modified Agassiz drift trawl evolved by Sheard, who will shortly describe it.

The depths at which the submarine light was used ranged down to 100 metres or more, but the bottle containing the lamp tended to leak at greater depths.

In night collecting with a submarine light, as many as a dozen species have been found in the net after a short immersion (twenty minutes). Generally, a superabundance of males, and in some cases males only, was attracted. On the other hand, Miss Patricia Mawson, to whom I am indebted for collections made from a jetty, secured only females and juveniles of *Cyclaspis usitata* on two occasions; this is discussed under the species.

Through the courtesy of the authorities of the Australian Museum, I have been able to examine the small collection of Cumacea in that institution; included is material taken by the H.M.C.S. "Thetis" in 1898 (for stations see Mem. Aust. Mus. iv, 1898, pp. 20-22).

My thanks are due to Miss Gwen Walsh for the drawings reproduced in fig. 1, 36 A to C, and 39.

(1) See also Hale, 1928, 1932, 1936, 1937, 1937a and 1943.

FAMILY BODOTRIIDAE.

SUBFAMILY BODOTRIINAE NOV.

Family Bodotriidae as formerly defined.

Genus CYCLASPIS.

This somewhat difficult and certainly now unwieldy genus embraces species exhibiting considerable differences in the shape and sculpture of the carapace. The three-score of species (including those described in this paper as new) can be regimented with a certain degree of finality, but in too many of them only one of the sexes is known, and a splitting at the present stage may lead to the premature proposal of numerous genera with one species or little more; *C. longicaudata* Sars, *carinata* Zimmer, *caprella* Hale and *cingulata* Calman, for instance, have outstanding distinctive features. On the other hand, the members of the *levis* group, with smooth exoskeleton, and large and prominent ocular lobe and lenses, seem scarcely congeneric with the *exsculpta* group; even so, there are difficulties in exact diagnosis and delimitation of the last-named, which, as at present known, is restricted to the Australian region.

DISTRIBUTION.

In fig. 1 the areas where *Cyclaspis* has been collected are enclosed in circles; the numerals refer to the number of species taken therein. A glance at this map shows that much more comprehensive collecting is necessary in the Southern

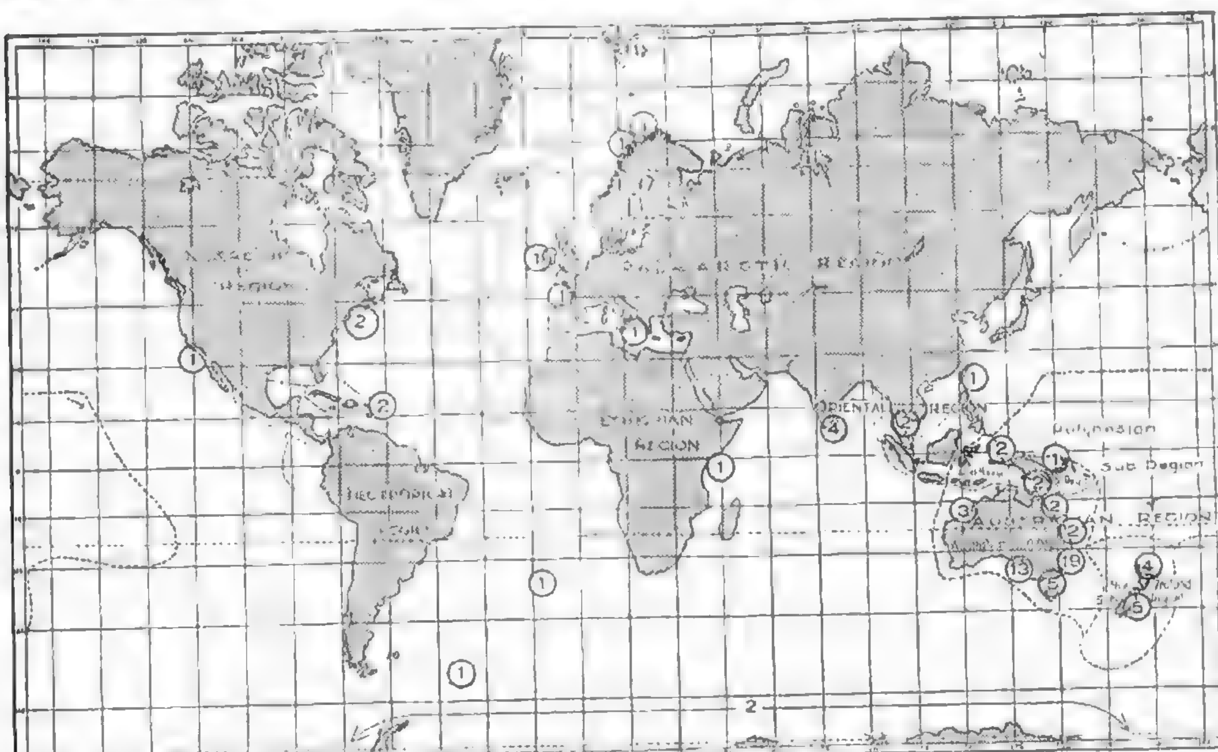

Fig. 1. Distribution of the Genus *Cyclaspis*.

Hemisphere before detailed conclusions as to distribution can be reached. Foxon (1923, p. 387), based his suggestions regarding the affinities of the Cumacea of north-eastern Queensland on material too limited to be of significance.

It seems certain that (as noted by Calman, 1907, p. 6) *Cyclaspis* is predominantly represented in the Indo-Pacific. Fig. 1 indicates, incidentally, the result of special efforts to obtain Cumacea off the coast of Australia; although collect-

ing has been carried out in only relatively small areas, more than half the described species have been taken there. Going a little further, and including the whole of the Australian region, we find in this region forty-four of the sixty-one known species.

The occurrences of the species are as follows:

ARCTIC OCEAN.
longicaudata Sars.

NORTH ATLANTIC OCEAN.
longicaudata Sars.
varians Calman.
unicornis Calman.
longipes Calman.

SOUTH ATLANTIC OCEAN.
spectabilis Zimmer.

INDO-PACIFIC OCEAN.

ETHIOPIAN REGION.
carinata Zimmer.

ORIENTAL REGION.
costata Calman.
picta Calman.
formosae Zimmer.
herdmani Calman.
hornelli Calman.
cingulata Calman.
uniplicata Calman.

AUSTRALIAN REGION (Australian Sub-region).

North-western Australia.
mjobergi Zimmer.
supersculpta Zimmer.
candida Zimmer.

South Australia.
caprella Hale.
sheardi sp. nov.
mjobergi Zimmer.
cretata sp. nov.
granulosa sp. nov.
pura Hale.
cottoni Hale.
tribulis Hale.
bovis Hale.
mawsonae sp. nov.
usitata Hale.
simula sp. nov.
spilotes Hale.

Victoria and Tasmania.
sheardi sp. nov.
clarki sp. nov.
tribulis Hale.
australis Sars.
munda sp. nov.

New South Wales.
gibba sp. nov.
lucida sp. nov.
mollis sp. nov.
fulgida sp. nov.
sheardi sp. nov.
cretata sp. nov.
concinna sp. nov.
globosa sp. nov.
clarki sp. nov.
pinguis sp. nov.
nitida sp. nov.
tribulis Hale.
bovis Hale.
usitata Hale.
aspera sp. nov.
australis Sars.
cana sp. nov.
munda sp. nov.
sabulosa sp. nov.

Southern Queensland.
strigilis sp. nov.
pruinosa sp. nov.

Northern Queensland.
levis Thomson.
similis Calman.

AUSTRALIAN REGION. Austro-Malayan Sub-region.
bicornis Zimmer.
pusilla Sars.
persculpta Calman.
exsculpta Sars.
sibogae Calman.

AUSTRALIAN REGION. New Zealand Sub-region.

North Island.
levis Thomson.
coelebs Calman.
argus Zimmer.
thomsoni Calman.

South Island.
levis Thomson.
calmani sp. nov.
elegans Calman.
similis Calman.
triplicata Calman.

AUSTRALIAN REGION. Polynesian Sub-region.
No species recorded.

NORTH-EASTERN PACIFIC OCEAN.
nubila Zimmer.

SOUTHERN OCEAN.
quadrituberculata Zimmer.

ANTARCTIC OCEAN.
glacialis Hansen.
gigas Zimmer.

KEY TO SPECIES.

Keys are necessarily arbitrary. In that dealing with the species of *Cyclaspis*, and presented herein, an attempt has been made to group as far as possible forms with broad structural features in common. Its use will necessitate a more than cursory examination of material in hand, but that is really necessary whatever form of summary is adopted.

Following the inevitable addition of forms as yet unknown and with fuller knowledge of some of those already recorded, there is no doubt that modification of the key will be necessary.

STRUCTURE.

Carapace. The primary surface pattern consists of the universal fine network (fig. 9, C; 32, D, etc.), often linked with faint pitting but always present even in the most polished forms. This minute reticulation may follow the formation of ridges in that the edges are placed end to end along the line of a carina, as in the only one occurring in *pinguis*, that of the dorsum, which runs the whole length of the animal (fig. 30, F). The relative size of the reticulation shows some specific variation.

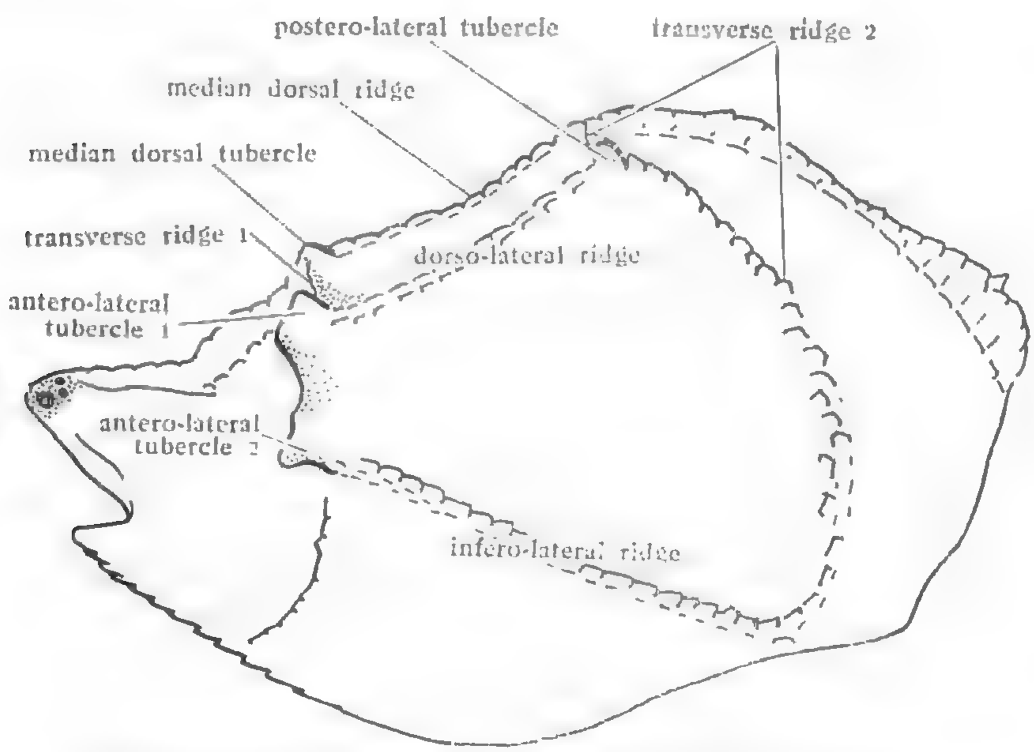

Fig. 2. Ridges and tubercles of carapace of *Cyclaspis tribulis* juvenile.

Superimposed, as it were, on the fine network, there may be a much larger secondary reticulation formed by a denser calcification of the edges of rather deep pits. This produces the honeycomb-like effect referred to by Zimmer in describing *bicornis* (1921a, p. 127, fig. 22); it is well-marked in some members of the *exsculpta* group and is illustrated herein for *mawsonae* (fig. 10). The edges of the secondary reticulation may be placed end to end so as to play a part in emphasizing true carinae *(mawsonae)* or pseudo-carinae *(bicornis)*.

The ridge most commonly present is that running along the mid-dorsal line; it is very rarely absent, but may be faint, particularly on the posterior half. Alongside the anterior half of it there is often a more or less distinct shallow depression

on each side. When these depressions are fairly pronounced, their hinder end is marked by a slight emargination of the dorsal outline and their lateral limits form a fold running from the middle of the length of the carapace to the posterior ends of the pseudorostral sutures, then approximately along the curve of the latter. The smooth appearance of the species in Section 1 of the key is scarcely, if at all, affected by these slight folds, and they are not to be confused with the true lateral ridges found in many forms of Section 2.

Again, in some species of Section 1, the edge of the short shallow gutter often present back of the antennal notch may be slightly emphasized to form the so-called antennal "ridge"; this is faint, but can be discerned by rotating the stage so as to vary the lighting.

The development of antero-lateral tubercles, one below the other, is a common but not universal feature in Section 2; there may also be one or (rarely) two postero-lateral elevations on each side. Both antero-lateral and postero-lateral tubercles may be crossed by carinae (into which they merge) or only one such ridge may be present; these transverse carinae may continue across the back *(exsculpta, persculpta, tribulis, australis,* etc.).

Recognition of the basic arrangement of the ridges and tubercles in the *exsculpta* group may present difficulties in some cases, unless juveniles as well as adults of both sexes are studied, a consummation devoutly to be desired but rarely possible. In the young of *tribulis*, for instance, all the ridges enclosing the depressed quadrilateral area on the side of the carapace are distinct, although the tubercles are small. The juvenile is used in fig. 2 to illustrate the plan of sculpture and the terminology.

The pair of small depressions, sometimes deep pits, at the base of the frontal lobe, have been referred to by Zimmer.

Elevation of the *mid-line* of the dorsum to form teeth is rare; it occurs in *unicornis* Calman, *bicornis* Zimmer, and *uniplicata* Calman.

Pedigerous somites. The exposure or concealment of the first somite seems to be of no special taxonomic import, nor do the marginal plumose hairs which Zimmer comments upon. The shape of the somites and their carinae are best described by illustrations, as is also the often distinctive contour of the dorsum of the second somite.

Pleon. The abdomen is fairly uniform in structure. It may be unusually long (*sibogae, cana*) or short (*gibba*); robust (male of some species, see for instance *sheardi*) or slender and flexible (*pinguis*). Articular pegs are usually, if not always, present but may be so inconspicuous that they are detected with some difficulty.

Peraeopods. Although the thoracic appendages exhibit no gross variation, the proportions of the joints are constant in adult or almost adult specimens of a species and there are other features worthy of note.

The terminology used in the present descriptions should be mentioned here. While recognizing its reasonableness, I have not adopted Hansen's nomenclature, but in order to avoid confusion and to facilitate comparison with earlier diagnoses have adhered as previously to the widely used coxa, basis, ischium, merus, carpus, propodus and dactylus for the joints 1 to 7 of Stebbing, etc. In Hansen's interpretation of the limb joints as found in most Peracarida, ischium, as here used, = *preischium;* merus = *ischium;* carpus = *merus;* and propodus = *carpopropodus.* It might perhaps be simpler to follow Stebbing's practice, but there again, his second joint equals Hansen's third, and so on.

The inner apical "angle" of the basis of the first peraeopod is in some species produced to form a subtriangular tooth-like process which may be comparatively pronounced (see *strigilis, cretata, granulosa, formosae, herdmani, hornelli,* etc. Almost always a long plumose seta is present at the external apical angle of this

joint and sometimes there is a shorter second apical seta, well separated from the first.

The second peraeopods are remarkably uniform in structure; the proportions of the joints vary little, but the relative lengths of the spines, particularly those of the distal end of the dactylus, are useful.

The third to fifth peraeopods, judging from the available specimens, and from reference to published figures, are similar in many of the species. Nevertheless, in the proportions of the joints and the number and length of the setae, they sometimes prove an aid in separating closely allied forms but do not conform in the groupings governed by the structure of the carapace. For instance, *tribulis*, a highly sculptured member of the *exsculpta* section, has posterior peraeopods similar to those of *mjobergi* (fig. 3, K), a "smooth" species. On the other hand, *globosa* and *pinguis* fall naturally together, but their posterior thoracic appendages are considerably different (cf. fig. 3, E and J).

Zimmer (1933, p. 334, fig. 2) described in detail the fifth peraeopod of *Diastylis rathkei*, drawing attention to the fact that the spines (or setae) of the carpus, propodus and dactylus of the posterior legs constitute a sort of digging scoop or rake (see also Foxon, 1936, p. 382, and Hale, 1943, pp. 341 and 342.

The following notes concerning the posterior peraeopods in *Cyclaspis* are based on the examinaton of twenty-nine Australian species which are available for study. Setae are usually present on the six distal segments of these limbs. In *globosa*, for instance (fig. 3, A), the inner face of the basis is provided with plumose bristles; the ischium bears two strong subapical setae, the merus has one; there is a fan of distal setae, approximating in number and length to those of the ischium, at the outer angle of the carpus and in this case an isolated seta on the outer margin; a single seta is articulated at the outer angle of the propodus, alongside the base of the dactylus, which has a small inner seta.

Other insignificant setae may be present; for instance, there is often a tiny bristle at the inner side of the longest carpal seta, and there may be one on the outside of the dactylus. The terminal joints of the posterior legs of thirteen Australian species are shown in fig. 3.

The propodal seta is always single, curved in the same direction as the dactylus and, except in *simula* (fig. 3, B), it is stout and reaches at least almost to the tip of the limb, sometimes far beyond it. The pronged fork formed by this seta and the dactylus is supplemented (again excepting *simula*) by a long seta at the outer distal angle of the carpus; this is as stout as the propodal seta and extends to about the level of the tip of the last-named; close to this are seated one to four thinner setae (successively decreasing in length and diameter if more than one is present); a few more widely separated setae may be present on the outer and sometimes inner margin also of the carpus (fig. 3, J, K, N).

These "fossorial" setae, and apparently always those of the ischium and merus also, are flexible, particularly in the distal half or third, where they are sometimes curled in preserved material (fig. 3, N). In the terminal half or third, the seta exhibits a slight narrowing and thence to the tip its chitin shows a distinct spiral structure (fig. 3, D^1 and E^1).

C. simula (fig. 3, B) constitutes a type apart in that the sole armature of the limb is an unusually feeble propodal spine and a short plumose seta on the basis; the species is known from a single subadult male.

Of the other available Australian species, *pruinosa*, *spilotes*, *pinguis*, *cretata*, *cana*, *caprella*, *gibba*, *sheardi*, *cottoni*, *strigilis*, *concinna*, *clarki*, and *granulosa* have only two carpal setae. In most of these the longest carpal seta and the propodal seta reach only to about the level of the tip of the dactylus, while the second carpal seta is rather feeble (fig. 3, C and D), or is not much more than half as long as the stouter one (fig. 3, E and F). On the other hand, the propodal

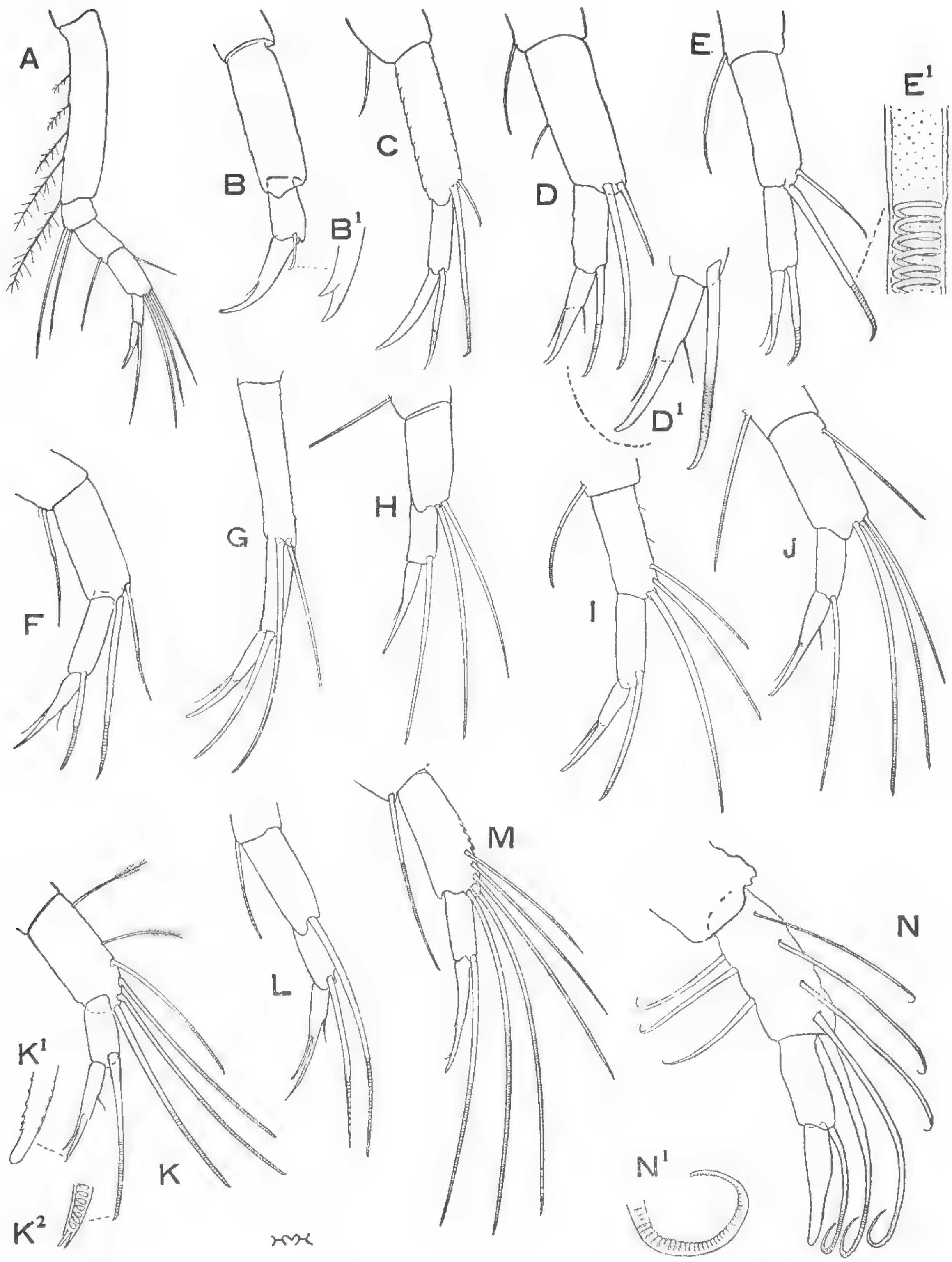

Fig. 3. Fourth peraeopods of *Cyclaspis* spp.; A, the whole limb; B to N, carpus, propodus and dactylus. A, *globosa;* B, *simula*; B1, apex of propodal seta. C, *pruinosa*; D, *spilotes*; D1, dactylus and propodal seta. E, *pinguis*; E1, seta at junction of flexible and proximal portions. F, *cretata*. G, *cana*. H, *caprella*. I, *aspera*. J, *globosa*. K, *mjobergi*; K1, tip of dactylus; K2, tip of seta. L, *tribulis*, 2·7 mm. juvenile. M, *lucida*. N, *bovis*; N1, apical portion of seta (A, × 52; B, E, F, H, J, L, M and N, × 145; C, × 110; D, G, I and K, × 95; B1, × 725; E1 × 1,150; K1, K2 and N1, × 400).

seta and longest carpal seta reach well beyond the tip of the dactylus in *cana* (fig. 3, G); *caprella* (fig. 3, H), and *cottoni* (fig. 35, F), while the second carpal seta is much more than half as long as the main one.

C. munda, fulgida, australis, mawsonae, aspera, globosa, nitida and *usitata* have three carpal setae; the longest reach to the tip of the dactylus in the first five species (as in fig. 3, I), but the propodal and two of the carpal setae are relatively much longer in *globosa* (fig 3, A and J), *nitida* (fig. 34, C) and *usitata* (fig. 41, D).

C. mjobergi, tribulis and *sabulosa* have long setae; the propodal and three of the four carpal setae here present reach to well beyond the apex of the dactylus (fig 3, K).

The greatest development of the fossorial setae is found in *mollis* and *lucida* (fig. 3, M), in which they are very long, with five on the carpus. In *hovis* also the setae are long, but are differently arranged (fig. 3, N); there are two setae at the distal outer angle of the carpus, preceded by three on the outer margin; there are also three on the inner face of this joint.

C. pura is a variable species in size and in the character of some of its appendages. The posterior peraeopods have two to three setae at the outer distal angle of the carpus and often one on the outer margin; the longest setae reach to the tip of the dactylus or a little beyond, sometimes well beyond.

A limited number of very juvenile specimens has been examined; it would seem that the setae are as long, or about as long, as in the adult but may be fewer in number. In *tribulis* for instance, the adult posterior legs are much as in fig. 3, K, but the 2·7 mm. juvenile has only one long carpal spine (fig. 3, L). On the other hand, in *usitata*, the setae at 2 mm. are as in the 7 mm. adult.

Uropoda. These appendages are recognized as useful aids to diagnosis by all authors, and with good reason. In mature or almost mature examples they vary very little in the same sex, but caution is necessary in dealing with young specimens.

Where strongly indurated forms are concerned, too much reliance cannot be placed upon the number of plumose setae present; they are brittle in such, and tend to be lost wholly or in part either during the wear and tear of life or after preservation. They are found in full number after ecdysis (fig. 43, E). Serrations and spines of the inner margins persist and their arrangement as well as number is of specific import.

The apices of both rami may be simple and acute, or the tip of the exopod and more rarely of the endopod also, may be narrowly truncate, with one or more articulated spines. Whatever their character, it is constant within a species.

Attention is here directed to minute articulated processes found always in some species of the *levis* group on the apex of the exopod. They appear to be modified or rudimentary spines and the term *mucrones* is here applied to them (see fig. 6, E; 31, C and J; 34, D, etc.). Each mucro is generally leaf-like and as many as three mucrones of unequal size may be present on the ramus. The presence of these mucrones affords real assistance in preliminary sorting of material as, although insignificant in size, when once recognized, they are easily discernible with the binocular at a low magnification. In the highly indurated *exsculpta* group, it seems that mucrones may be present in the young but absent in the adult, for instance, *hovis* and *tribulis*; in the last-named, the apex of both endopod and exopod bears a mucro in the shape of a very minute spine, but in the adult the tips of the rami are dilated (exopod) or subacute (cf. fig. 36, H and E). On the other hand, the adult of *aspera* has always two inconspicuous mucrones on the narrowly truncate apex of the exopod (fig. 46, F), and in *sabulosa* there is a flattened mucro on the exopod of the adult (fig. 58, G, and 60, C^1).

KEY TO SPECIES OF *CYCLASPIS.*

SECTION 1.

Sides of carapace without ridges or tubercles in either sex.

Viewed from above the lateral contour of the carapace is always evenly curved or slightly sinuate from posterior margin to front of pseudorostral lobes and it is never abruptly wider across the region of the last-named.

Usually polished and perfectly smooth except for the universal reticulate patterning, but sometimes slightly roughened owing to the presence of granules (*granulosa, sheardi*, etc.), or raised edges of reticulations (*clarki*) or many fine striae (*costata* and *strigilis).*

1. Front margin of carapace with an acute, forwardly directed spine on each side, below antennal angle .. .. *caprella* Hale.
   No spines at front of carapace .. .. 2.
2. A prominent tooth on mid-line of dorsum of carapace .. .. .. 3.
   No prominent tooth on mid-line of dorsum of carapace .. .. .. 4.
3. A small median dorsal tooth at base of ocular lobe; rami of uropod slender, with simple apices .. .. *bicornis* Zimmer.
   No tooth at base of ocular lobe; rami of uropod wide, with articulated apical spines *unicornis* Calman.
4. Pseudorostral lobes meeting for an appreciable distance in front of ocular lobe .. 5.
   Pseudorostral lobes barely or not meeting in front of ocular lobe (*levis group*) .. 13.
5. Eye entirely absent .. .. 6.
   Eye developed, prominently pigmented (*picta group*) .. .. .. 7.
6. Carapace subglobose; pseudorostrum short. Peduncle of uropod shorter than rami *longicaudata* Sars.
   Carapace compressed; pseudorostrum long. Peduncle of uropod more than twice as long as rami .. .. *carinata* Zimmer.
7. Carapace with a low, median, dorsal projection at posterior end .. .. *gibba* sp. nov.
   Carapace without median, dorsal projection at posterior end .. .. .. 8.
8. Carapace with many longitudinal rows of minute granules. Peduncle of uropoda not longer than telsonic somite .. .. *costata* Calman.
   Carapace smooth. Peduncle of uropoda much longer than telsonic somite .. .. 9.
9. Both rami of uropod with at least one articulated terminal spine .. .. 10.
   Both rami of uropod without terminal spine .. .. 11.
10. First peraeopod short, with carpus not reaching level of antennal tooth. Rami of uropod barely half as long as peduncle .. .. *picta* Calman.
    First peraeopod long, with carpus reaching level of antennal tooth. Rami of uropod about two-thirds as long as peduncle .. .. .. *varians* Calman.
11. Peduncle of uropod one and two-third times as long as exopod, which bears a mucro. Carpus of first peraeopod one-third as long again as propodus .. .. *lucida* sp. nov.
    Peduncle of exopod not or little longer than exopod, which is without mucro. Carpus of first peraeopod not longer than propodus .. .. 12.
12. Setae of third to fifth peraeopods long; five on carpus, the longest reaching for nearly half their length beyond tip of dactylus .. .. *mollis* sp. nov.
    Setae of third to fifth peraeopods short; three on carpus, none reaching beyond tip of dactylus .. .. *fulgida* sp. nov.
13. Endopoda of uropoda with apex acute and without articulated terminal spines .. 14.
    Endopoda of uropoda with at least one articulated terminal spine .. .. 31.
14. Exopoda of uropoda with apex acute and lacking terminal spines or mucrones .. 15.
    Exopoda of uropoda with one or more articulated terminal spines or mucrones .. 27.
15. Carapace with numerous fine longitudinal striae .. .. *strigilis* sp. nov.
    Carapace without longitudinal striae .. .. 16.
16. Carapace with a low median dorsal projection at posterior end .. .. .. 17.
    Carapace without median dorsal projection at posterior end .. .. .. 18.

17. Carapace with dorsal carina distinct for whole length and with a conspicuous pit on each side alongside posterior median projection. Peduncle of uropod longer than rami *sheardi* sp. nov.
Carapace with dorsal carina obsolete for posterior two-thirds of length; no conspicuous pits at posterior end. Peduncle of uropod shorter than rami .. *mjobergi* Zimmer.

18. Carapace not globose, compressed in the male and young female. Uropods slender, the peduncle longer than telsonic somite .. .. 19.
Carapace globose in both sexes. Uropods stout, the peduncle shorter than, or barely as long as, telsonic somite .. .. 24.

19. Propodus of first peraeopods almost as long as merus and carpus together .. .. 20.
Propodus of first peraeopods subequal in length to carpus .. .. .. 21.

20. Inner margin of endopod of uropod with a row of setae, followed by seven to eight slender spines (adult male) .. .. *levis* Thomson.
Inner margin of endopod of uropod with three to six proximal spines, followed by a row of fifteen to twenty-three shorter spines (both sexes) .. .. .. *cretata* sp. nov.

21. Carapace roughened with fine granules .. .. .. *granulosa* sp. nov.
Carapace not granulate .. .. 22.

22. Basis of first peraeopods with a large apical tooth-like projection, reaching to distal margin of ischium. Peduncle of uropod not longer than rami .. .. .. 23.
Basis of first peraeopods without large apical tooth. Peduncle of uropod longer than rami *concinna* sp. nov.

23. Rami of uropod longer than peduncle (subadult female) .. *formosae* Zimmer.
Rami of uropod equal in length to peduncle (ovigerous female) .. *herdmani* Calman

24. Size small, ovigerous female 3·5 mm. Ocular lobe dilated anteriorly, with prominent circular dark lenses .. .. *pusilla* Sars.
Size large, ovigerous female 7 mm. or more. Ocular lobe not dilated anteriorly but somewhat triangular, with lenses pale and elongate .. .. 25.

25. Carapace overhanging second pedigerous somite posteriorly. Third to fifth peraeopods with long setae (fig. 3, A and J) .. .. *globosa* sp. nov.
Carapace not overhanging second pedigerous somite. Third to fifth peraeopods with short setae (fig. 3, E) .. .. 26.

26. Carapace coarsely pitted, slightly rugose. Pleon robust. Dactylus of second peraeopods with longest terminal spine shorter than propodus and dactylus together and with the two remaining apical spines subequal .. .. *clarki* sp. nov.
Carapace smooth. Pleon slender. Dactylus of second peraeopods with longest terminal spine as long as propodus and dactylus together, and with the two remaining apical spines unequal *pinguis* sp. nov.

27. Exopoda of uropods with one or more mucrones .. .. 28.
Exopoda of uropods with one or more spines .. .. 29.

28. Peduncle of uropod at most half as long again as rami (adult male) .. *pura* Hale.
Peduncle of uropod two-thirds as long again as rami (adult male) .. *nitida* sp. nov.

29. Basis of first peraeopods only three-fourths as long as rest of limb and with an apical tooth, reaching distal margin of ischium .. .. .. *hornelli* Calman.
Basis of first peraeopods subequal in length to rest of limb, with apical tooth short or absent .. .. 30.

30. First peraeopods with propodus longer than carpus which is subequal in length to dactylus; no tooth at apex of basis (= *levis* Calman, *nec* Thomson) .. *calmani* sp. nov.
First peraeopods with propodus subequal in length to carpus which is much longer than dactylus; a short tooth at apex of basis, reaching middle of length of ischium *cottoni* Hale.

31. First peraeopods unusually long and slender, the basis not much more than half as long as rest of limb .. .. *longipes* Calman.
First peraeopod short, the basis distinctly longer than rest of limb *nubila* Zimmer.

SECTION 2.

Sides of carapace never smooth, but with ridges or tubercles, or both.

Viewed from above the lateral contour of the carapace, owing to the sculpture, is rarely evenly curved, particularly in the female; when antero-lateral tubercles are developed it is often abruptly widest across the hinder part of the pseudorostral lobes in the male.

1. Carapace encircled by a collar-like ridge .. .. .. *cingulata* Calman.
Carapace not encircled by a collar-like ridge .. .. 2.

2. Sides of carapace never almost smooth, with at least one tumidity (antero lateral tubercle) or obtuse tooth-like projection below pseudorostral suture .. .. .. 3.
Sides of carapace almost smooth, with no tumidity or other projection below pseudorostral suture .. .. 24.

3. A depressed quadrilateral area on each side of carapace in at least female, the edges defined by ridges or the corners marked by prominent projections (*exsculpta group*) .. 4.
No depressed quadrilateral area on side of carapace .. .. 15.

4. Carapace with two transverse ridges on back in female; the first connects the upper antero-lateral tubercles of each side and the posterior one may be absent in the male .. 5.
Carapace with one transverse ridge (crossing back in posterior half), or none .. 12.

5. With a post-ocular tubercle on mid-line of carapace, immediately in front of first transverse carina .. .. *tribulis* Hale.
No post-ocular tubercle on mid-line of carapace .. .. 6.

6. Carapace with antero-lateral tubercle large, elevated and tooth-like; posterior transverse carina produced on each side of back, forming a pair of conspicuous teeth .. .. 7.
Carapace with antero-lateral tubercle and posterior transverse carina not elevated to form large teeth .. .. 8.

7. Peduncle of uropod subequal in length to rami (subadult female) *persculpta* Calman.
Peduncle of uropod much longer than rami, more than twice as long in subadult female *bovis* Hale.

8. Carapace with ridges swollen; dorso-lateral carinae as well as median carina on posterior part projecting slightly beyond hinder margin as three tubercles .. .. .. 9.
Carapace with ridges not swollen; no dorso-lateral carinae on posterior part, so that only one tubercle (median) occurs at hind margin .. .. 10.

9. Estimated length, subadult female, under 5 mm.; a short ridge running forward from lower antero-lateral tubercle .. .. *exsculpta* Sars.
Length, subadult female, 10 mm.; no ridge running forward from lower antero-lateral tubercle .. .. *supersculpta* Zimmer.

10. With a longitudinal ridge from below antennal tooth almost to end of carapace (male) *mawsonae* sp. nov.
With no such ridge .. .. 11.

11. Mid-dorsal projection at hinder end of the slender carapace feeble; ridges feeble, the second transverse carina widely interrupted on back. Dorsal margin of second pedigerous somite oblique .. .. *candida* Zimmer.
Mid-dorsal projection at hinder end of rotund carapace large; ridges well defined, the second transverse carina not widely interrupted on back. Dorsal margin of second pedigerous somite elevated .. .. *usitata* Hale.

12. Cephalothorax and pleon covered with small spines; no ridges on back or sides of carapace *aspera* sp. nov.
Cephalothorax and pleon not covered with small spines; well-defined ridges on sides of carapace .. .. 13.

13. A transverse carina across posterior part of back .. .. .. *australis* Sars.
No transverse carinae on back .. .. 14.

14. Quadrangular area on side of carapace with four prominent tubercles *elegans* Calman.
Quadrangular area on side of carapace with one or two prominent tubercles *similis* Calman.

15. Sides of carapace with tubercles or ridges posterior to the one or two antero-lateral tubercles .. .. 16.
Sides of carapace without elevation posterior to the antero-lateral tubercles .. 23.

16. Side of carapace with three obliquely transverse carinae .. .. .. 17.
Side of carapace with one transverse curved carina or none .. .. .. 18.

17. Carapace unusually small, less than half as long as pleon in female, and without mid-dorsal projection at hinder margin .. .. *sibogae* Calman.
Carapace more than half as long as pleon and with a mid-dorsal projection at hinder margin *triplicata* Calman.

18. With a longitudinal ridge from antennal tooth to about middle of length of carapace .. 19.
With no long ridge running back from antennal tooth .. .. .. 20.

19. Dorsum of carapace, as seen from side, rising abruptly to an obtusely angular peak at middle of length .. .. *simula* sp. nov.
Dorsum of carapace smoothly rounded .. .. .. *coelebs* Calman.

20. Side of carapace with a curved, swollen ridge on posterior portion .. .. 21.
Side of carapace with a tubercle, but no ridge, on posterior portion .. .. 22.

21. Eye lenses absent .. .. *glacialis* Hansen.
Eye lenses present (? = *glacialis*) .. .. *gigas* Zimmer.

22. Carapace subcylindrical, less than half as long as pleon and with two antero-lateral tubercles and a tubercle at termination of pseudorostral suture (male) .. .. *cana* sp. nov.
Carapace subglobose, half as long as pleon with one antero-lateral tubercle and no tubercle at end of pseudorostral suture (male) .. .. .. *quadrituberculata* Zimmer.

23. Eye lobe as wide as long. First peraeopod slender, with basis considerably longer than rest of limb, and dactylus about as long as carpus .. .. .. *munda* sp. nov.
Eye lobe narrow, much longer than wide. First peraeopod not slender, with basis equal in length to rest of limb and dactylus less than half as long as carpus *pruinosa* sp. nov.

24. Eye lenses absent and carapace globose with one short ridge on each side. Peduncle of uropod stout, not half as long as telsonic somite .. .. *spectabilis* Zimmer.
Eye lenses prominent and carapace compressed with one or two fine or faint ridges on each side. Peduncle of uropod elongate, as long or longer than telsonic somite .. .. 25.

25. Carapace with a prominent mid-dorsal tooth over base of eye-lobe *uniplicata* Calman.
Carapace with no dorsal tooth .. .. 26.

26. A slight but obvious incision in dorsal margin of carapace at middle of length. Exopod of uropod with no apical spine, but with mucro .. .. *sabulosa* sp. nov.
No incision in dorsal margin of carapace at middle of length. Exopod of uropod with slender apical spine .. .. 27.

27. With one ridge on each side of carapace. Propodus of first peraeopods much longer than dactylus .. .. 28.
With two ridges on each side of carapace. Propodus of first peraeopods sub-equal to dactylus .. .. *argus* Zimmer.

28. Side ridge of carapace faint, short and transverse, confined to posterior half of carapace *thomsoni* Calman.
Side ridge of carapace fine but distinct, curving obliquely forwards from middle of length of dorsal carina almost to inferior margin .. .. .. *spilotes* Hale.

SECTION 1.

Carapace with an anterior, lateral horn on each side.

Cyclaspis caprella Hale.

Cyclaspis caprella Hale, 1936, p. 395, fig. 1–2.

Unique because of the forwardly directed acute horns at the front of the carapace, a feature not found in any other member of the genus *Cyclaspis*. The pair of dorso-lateral elevations on each of the last two pedigerous somites and first pleon somite are also distinctive.

Males and subadult females, taken by townet and submarine light, are in hand from several localities in Spencer Gulf, where the type male was secured.

In the adult male, as viewed from the side, the dorsal portion of the anterior margin of the second pedigerous somite forms an open V with the upper part of the hinder edge of the carapace; the dorso-lateral "tubercles" of the fourth and fifth pedigerous somites are acutely triangular and tooth-like; the pair on the first pleon somite are obtuse (misprint "obscure" in original description) and subtriangular.

Subadult males and females have only a very small V-shaped dorsal incision between the carapace and the second pedigerous somite; the dorso-lateral elevations of the last two pedigerous somites are less acute and those of the first pleon somite are quite different, having the form of slender, acute, procurved and divergent thorns.

The exopod of the uropod bears two slender apical mucrones of almost equal length.

picta group.

Carapace moderately compressed with back rather rounded and median carina faint, particularly on posterior half; pseudorostral lobes meeting for an appreciable distance in front of the large ocular lobe and rather narrowly truncate anteriorly.

Apices of both rami of uropods simple, or both with spines, or exopods with mucrones.

The carapace is inclined towards the subglobose in the female of *costata*, *picta* and the four Australian species.

CYCLASPIS GIBBA sp. nov.

Ovigerous female. Integument smooth, finely reticulate and having the appearance of very shallow pitting; thin and not calcified.

Carapace relatively large, more than one-third of total length of animal; greatest width, which is in posterior half, is equal to the depth and two-thirds of

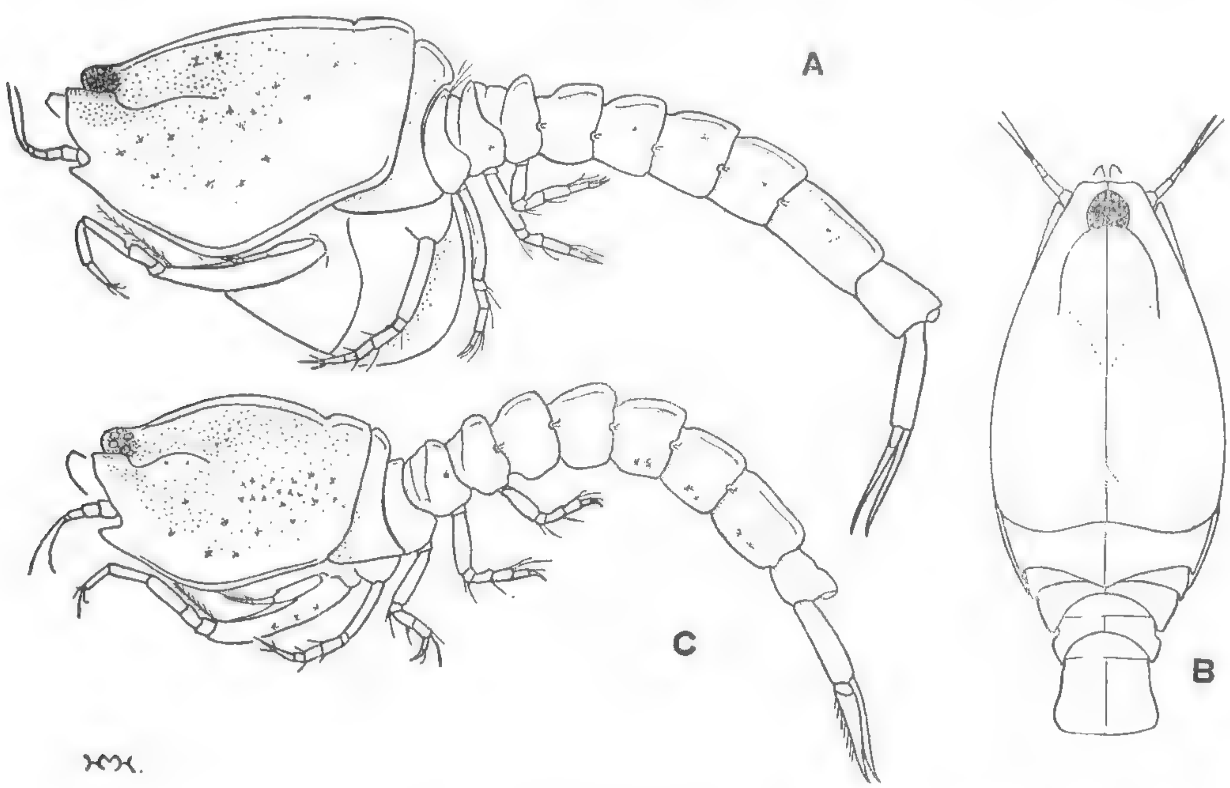

Fig. 4. *Cyclaspis gibba,* type female; A, lateral view and B, cephalothorax from above. C, Lateral view of paratype subadult female (× 32).

length; dorsum with a sharp, longitudinal median carina, emarginate at about five-sixths of length and slightly more markedly elevated posterior to the incision; there is a faint depression on each side of the anterior half of the dorsal carina. Antennal notch large and wide, and antennal tooth subacute. Pseudorostral lobes meeting in front for a short distance (about one-fourth of length of ocular lobe). The ocular lobe (as wide as long) is elevated, barely constricted basally, and is strongly pigmented, but with the lenses (apparently nine or so) not distinct; when the animal is viewed from the side the eye is very prominent.

The whole cephalothorax is ovoid when seen from above (fig. 4, B).

Pedigerous somites together half as long as carapace; first wholly concealed; second to fourth with distinct dorsal carina and fifth with feeble dorso-lateral carinae also; second somite overhanging the third in the mid-line and with the dorsal ridge almost crest-like, arched and sloping down from the dorsal outline of carapace.

Pleon (as noted) relatively small; with a distinct median carina, and with feeble dorso-lateral carinae on first to fifth somites; articular pegs small.

First antennae stout and, for *Cyclaspis,* conspicuous; second and third segments of peduncle subequal in length, together longer than the basal joint, and each about as long as the two-jointed flagellum; the jointed terminal appendages are as long as last peduncular and flagellar segments together.

First peraeopod short and stout, the propodus reaching level of antennal tooth; the robust basis is equal in length to the rest of the limb, with the inner apical angle produced and tooth-like, and with an unusually long plumose seta at external apical angle, reaching to distal end of carpus; propodus shorter than carpus (five-sixths as long) and one-fourth as long again as dactylus.

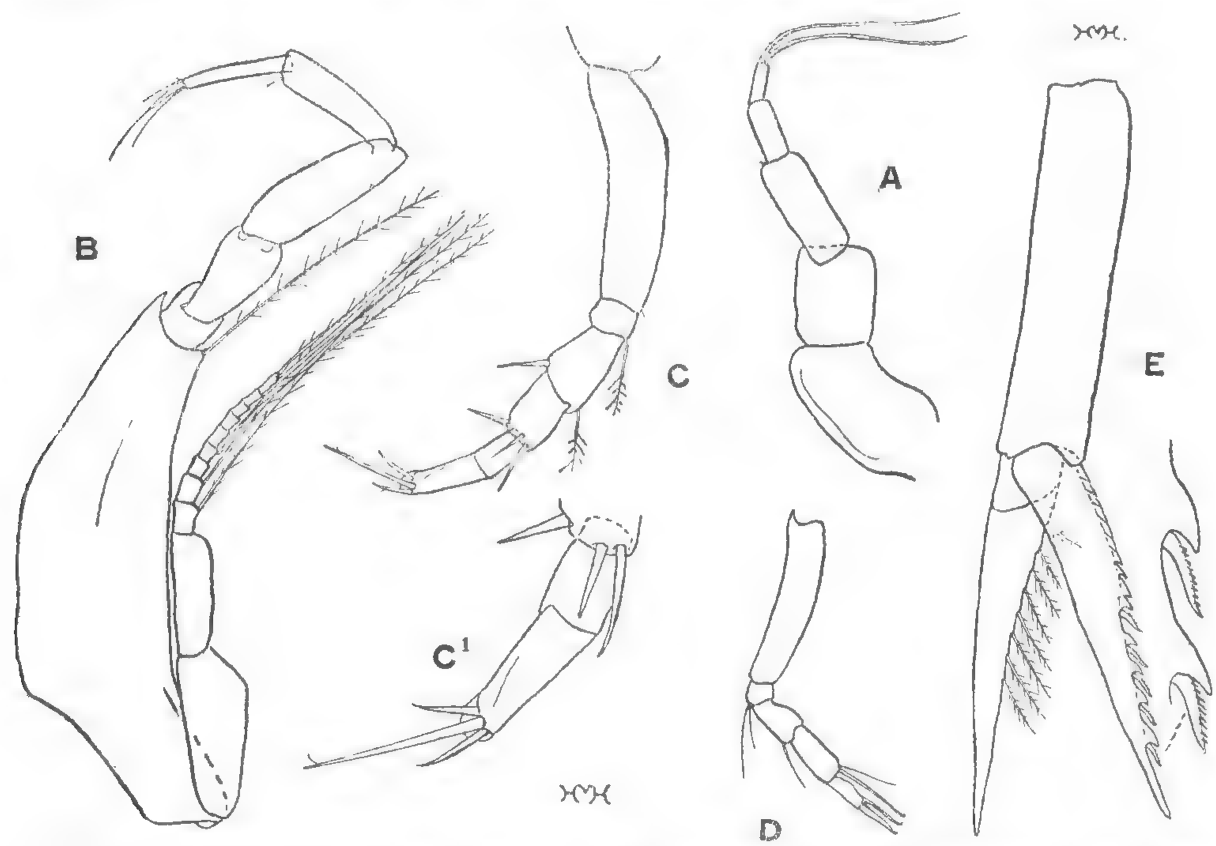

Fig. 5. *Cyclaspis gibba,* type female; A, first antenna; B, C and D, first, second and fourth peraeopods; E, uropod (A and C1, × 200; B to E, × 100).

Second peraeopods with basis shorter than rest of limb; ischium with a plumose seta; merus shorter than carpus and propodus together, with a strong apical spine, and at opposite angle a plumose seta; carpus with three spines on distal margin; propodus (unarmed as usual) more than half as long as dactylus, which has at apex a spine longer than itself and two equal spines barely one-half its length.

Fossorial legs with setae sparse and short (fig. 5, D), none reaching beyond tip of dactylus.

Uropods stout; peduncle much longer than the rather short telsonic somite and as long as the rami, which are equal in length, wide, and tapering to simple, acute apices; exopod with eight plumose setae, on the proximal two-thirds of inner margin of second segment; endopod with most of inner margin serrate; the serrations are closed (confluent) on proximal half, but these are followed by five widely open incisions in each of which is seated a serrated, slightly sinuate spine.

Colour: semi-transparent with dark stellate spots.

Length 3 mm.

Subadult female. The differences are best shown by a comparison of fig. 4, A and C. The carapace is a little deeper and wider, the antennal notch is more open, and the fifth pleon somite is shorter than in the adult, while the second thoracic somite is scarcely backwardly produced dorsally.

Length 2·6 mm.

Loc. New South Wales, off Jibbon, 30 fath. (K. Sheard, submarine light, May 1943). Type ovigerous female in South Australian Museum, Reg. No. C. 2415.

This species has a characteristic general facies owing to the emargination, near the hinder margin, of the dorsal edge of the large and robust carapace, the large antennal notch, the prominent ocular lobe, etc.

C. sheardi has a somewhat similar elevation at the hinder end of the carapace but otherwise is so entirely different that it cannot be confused with *gibba*.

CYCLASPIS LUCIDA sp. nov.

Ovigerous female. Like the following species *(mollis)* in structure of carapace, pedigerous somites and pleon, and with the last four pairs of peraeopods similar; the first peraeopods and the uropods, however, distinguish it, while the following comparative details may be noted.

Antennal notch moderately open and tooth subacute (fig. 6, A). First antenna with basal segment of peduncle longer than second and third together, and with third longer than second.

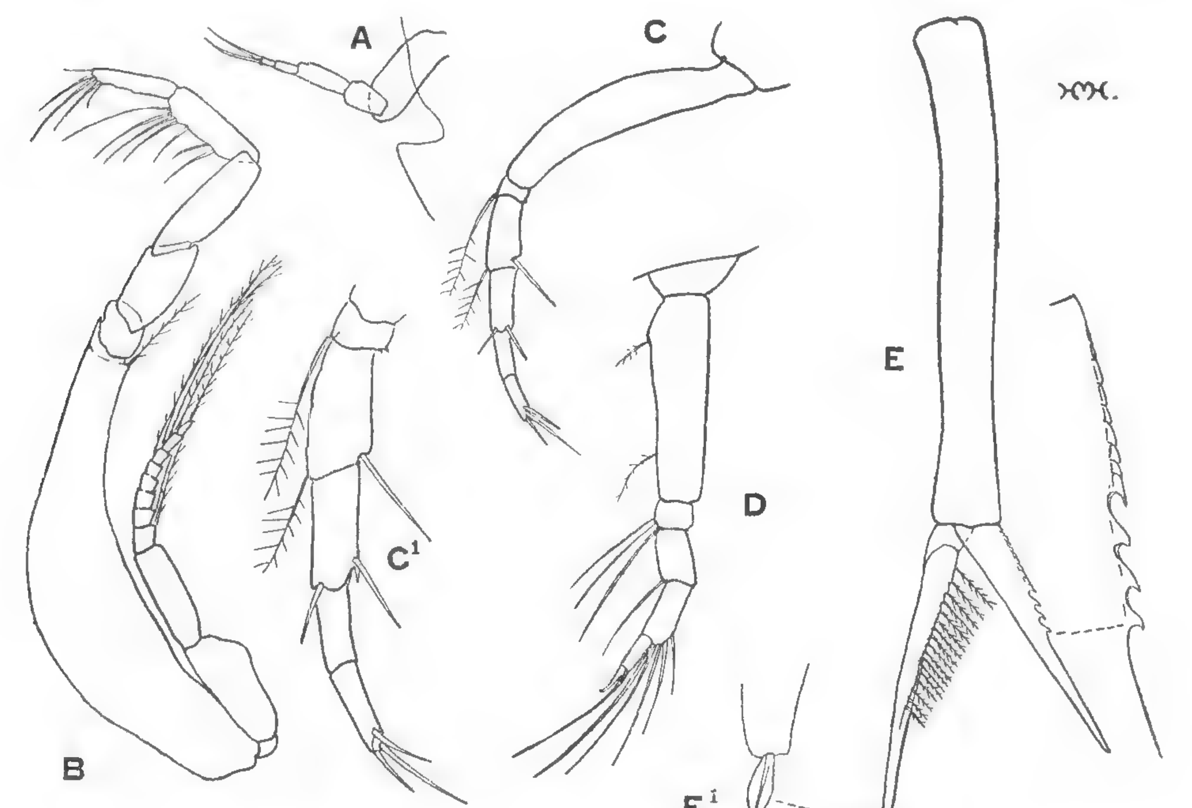

Fig. 6. *Cyclaspis lucida*, type female; A, first antenna and antennal notch; B, C and D, first, second and fourth peraeopods; E, uropod; E1, mucro of exopod of uropod (A to E, × 67; C1, × 134; E1, × 335).

Basis of first peraeopods a little longer than rest of limb, the apex with the usual external seta, and with a prominent tooth at inner angle; carpus, propodus and dactylus stout; carpus one-third as long again as propodus and half as long again as dactylus.

Second peraeopods with basis as long as rest of limb; ischium with a plumose seta; merus slightly longer than carpus but shorter than propodus and dactylus together. with a long but feeble inner subapical spine, and an outer apical plumose seta; carpus with two distal spines; propodus and dactylus subequal in length.

Third to fifth peraeopods with long setae (fig. 3, M. and 6, D), those of carpus and propodus reaching well beyond tip of dactylus; carpus of third and fourth with five fossorial setae, those of fifth with four.

Uropods with peduncle one and two-thirds times as long as the exopod, which is one-sixth as long again as the endopod; exopod, with a row of seventeen plumose setae, leaving distal third unfurnished, and with a mucro at apex; endopod without spinules, but with four prominent serrations, preceded by closed incisions, in proximal half of inner edge, posterior to which the branch tapers narrowly to its acute apex.

Colour white, with sparse, sooty chromatophores.

Length, 5 mm.

Loc. New South Wales: Cronulla, 8 feet (K. Sheard, submarine light, Sept. 1942). Type in South Australian Museum, Reg. No. C. 2400.

CYCLASPIS MOLLIS sp. nov.

Ovigerous female. Integument smooth and polished, without pitting or granulation, but with a regular, minute reticulate or squamose patterning; thin and not calcified, so that it bends but does not fracture under pressure.

Carapace with upper margin in lateral view, and sides as seen from above, smoothly and quite markedly curved, without any sign of projections; in dorsal view it is ovoid; length almost two-sevenths of total length of animal; widest at second third of length, where it is two-thirds its length; dorsum with a low carina, which is most distinct on anterior half, where it is flanked by a shallow depression on each side; thence, as it continues back, it is wider but more feeble, terminating before it reaches the hinder margin, which is evenly rounded and in side view slopes obliquely downward and forward. Antennal notch wide, rounded, and antennal angle acutely rounded. Pseudorostral lobes meeting in front for a distance equal to almost half the length of eye-lobe, which is subtriangular in shape not constricted at base, broad (as wide as long) with prominent brown pigment and with large but obscurely defined lenses.

Exposed pedigerous somites together much more than half as long as carapace. First somite only partly concealed, the exposed portion short; second somite longer than third, fourth or fifth somites, with anterior margin parallel to posterior edges of carapace, the dorsum smoothly rounded in side view and continuing the dorsal outline of carapace; second to fifth somites with a feeble median dorsal carina.

Pleon with feeble articular pegs and with a faint median dorsal ridge on each somite; first to fourth somites subequal in length, each only two-thirds as long as fifth; telsonic somite distinctly shorter, not much more than half length of fifth.

First antennae relatively long; first joint of peduncle not quite as long as second and third segments together; third as long as second and less than twice as long as the flagellum, which is two-jointed, the first joint nearly twice as long as second; two short, four-jointed sensory apical appendages (? damaged, fig. 8, A).

Third maxillipeds stout; basis geniculate, less than twice as long as remaining segments together, and expanded externally at apex, the lobe not reaching much beyond level of apex of ischium and with stout plumose setae; merus expanded externally, the apex of lobe attaining level of outer anterior angle of carpus, which is widest and subtruncate apically; carpus longer than dactylus, widest anteriorly, more than half as long as merus or carpus, which are subequal in length.

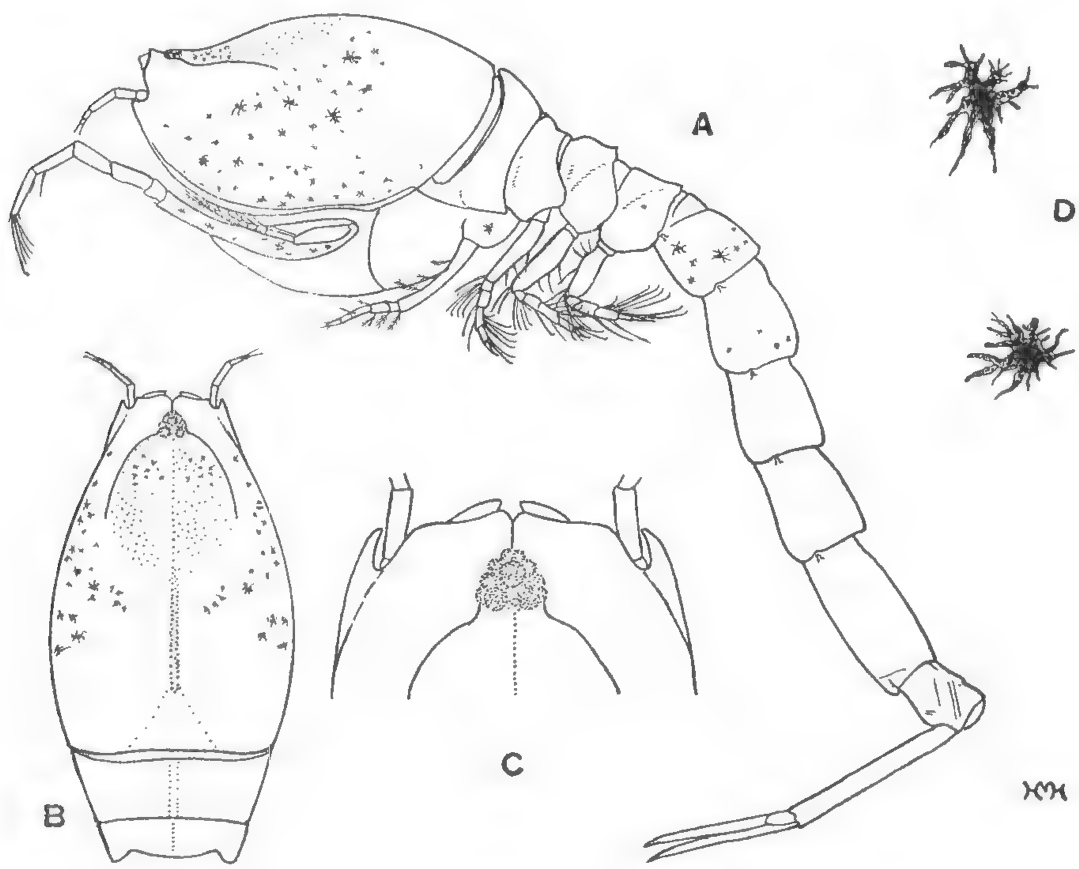

Fig. 7. *Cyclaspis mollis*, type female; A, lateral view; B, carapace and anterior pedigerous somites from above; C, anterior portion of carapace; D, chromatophores (A and B, × 19; C, × 45; D, × 120).

First peraeopods long, merus reaching level of antennal tooth; basis longer than rest of limb, with a plumose seta at outer apical angle and a tiny tooth at inner angle; carpus, propodus and dactylus subequal in length, merus a little shorter; dactylus stout, with several long terminal setae.

Second peraeopods slender, with basis about as long as remaining joints together; merus and carpus of almost equal length, each about as long as propodus and dactylus together; propodus four-fifths as long as dactylus, which has the three apical spines unusually weak, the longest almost as long as dactylus and with tip slightly curved (fig. 8, D); basis, ischium and merus with long, plumose setae but no spines; carpus with a subapical slender spine.

Third to fifth peraeopods richly furnished with long, stout setae (fig. 8, E and F), those of carpus and propodus reaching well beyond apex of dactylus; basis stout, in third and fourth legs as long as rest of limb, in fifth shorter; merus in all three not very markedly shorter than carpus and longer than propodus.

Uropods long, the peduncle longer than fifth pleon somite and about twice

as long as telsonic somite; rami slender, subequal in length, four-fifths as long as peduncle and with apices subacute, rounded; exopod with half a dozen plumose setae on first half of inner margin; endopod with eight serrations, each set with a spinule, at about middle third of inner edge.

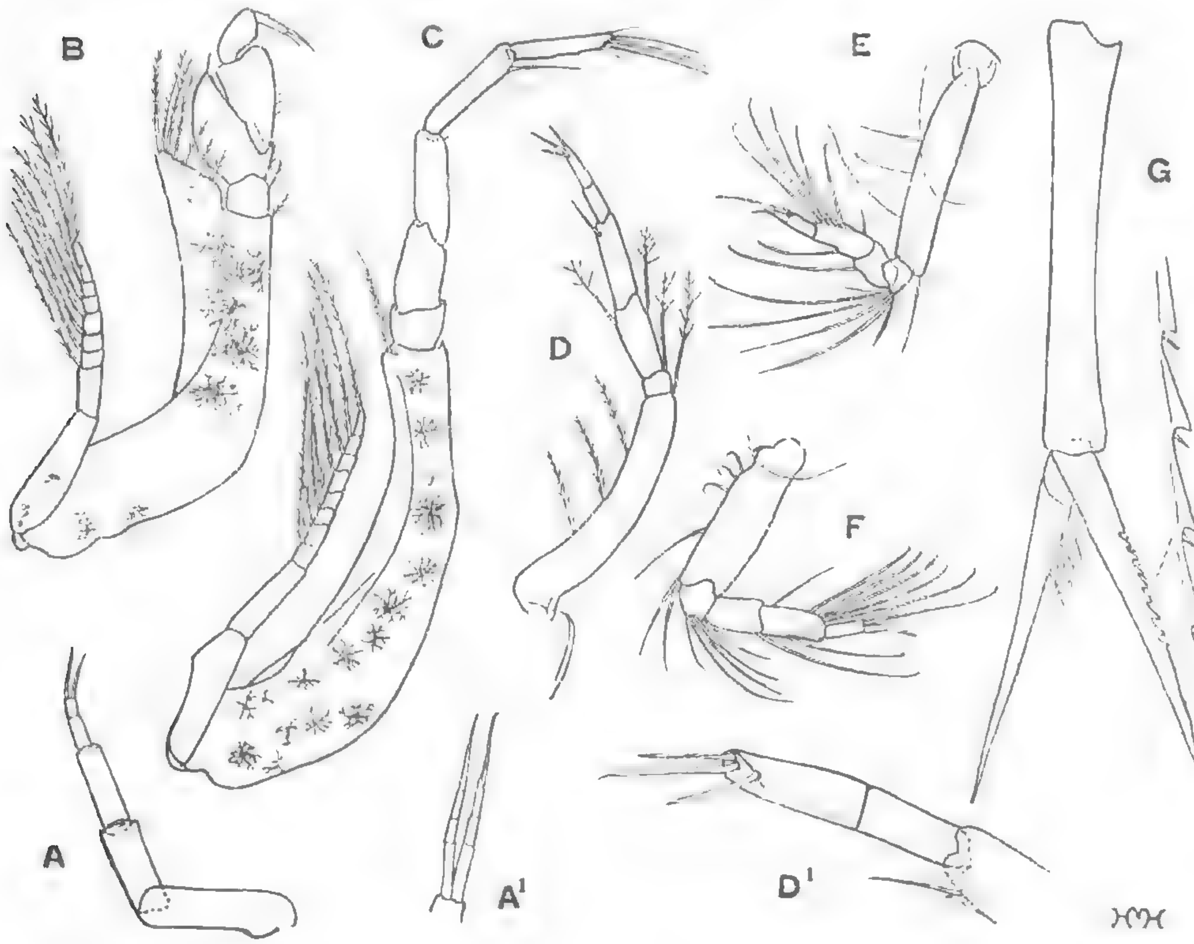

Fig. 8. *Cyclaspis mollis*, type female; A, first antenna and A1, its sensory terminal appendages; B, third maxilliped; C to F, first, second, third and fifth peraeopods; D1, terminal joints of second peraeopod; G, uropod (A, × 67; A1, × 175; B to G, × 40; D1, × 120).

Colour white, with large and small brown stellate spots as shown in figures.

Length 6·6 mm.

Loc. New South Wales: Cronulla, 8 feet (K. Sheard, submarine light, Sept. 1942). Type in South Australian Museum, Reg. No. C. 2399.

CYCLASPIS FULGIDA sp. nov.

Ovigerous female. Integument smooth and polished, with minute, fairly regular reticulate patterning (fig. 9, C), thin and scarcely calcified, but slightly stronger than in *mollis*.

Carapace ovate in dorsal view, with upper edge as seen from the side, and lateral contours from above, evenly and smoothly curved; there is, however, an almost imperceptible emargination in the dorsal outline at about the middle of the length and marking the hinder limit of a shallow lateral depression lying on each side of a low median carina, which continues towards the posterior end

of the carapace as a wider flattened area, giving the appearance of a faint double ridge. The length of the carapace is more than two-sevenths that of the whole animal; twice as long as deep, and widest at middle of length where it is distinctly wider than deep. Antennal notch wide; antennal tooth subacute, with a short, obsolete ridge leading back from it for a short distance. Pseudorostral lobes meeting in front for a distance equal to only about one-fourth of length of ocular lobe. Ocular lobe prominent, elevated, very slightly longer than wide, and not constricted at base; it is darkly pigmented and ten black lenses are developed.

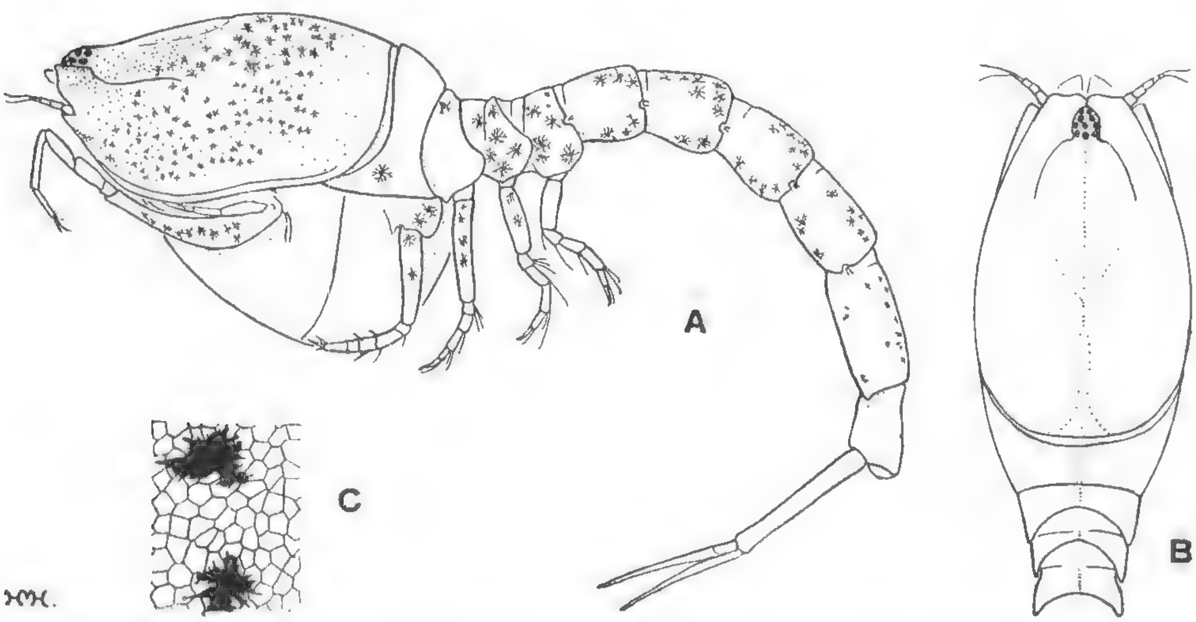

Fig. 9. *Cyclaspis fulgida*, type female; A, lateral view; B, cephalothorax from above; C, reticulate pattern and chromatophores of integument (A and B, × 20; C, × 175).

Five pedigerous somites are exposed; together they are much more than half as long as the carapace; second somite as long as third and fourth together, smoothly tapering, and in side view continuing the even curve of the dorsal margin of the carapace.

Pleon with a faint median carina and with feeble articular pegs; first to fifth somites successively increasing in length, the fifth only one-fourth as long again as the fourth; telsonic somite as long as third, with shallow dorsal notch.

First antennae relatively long; the first segment of the peduncle is as long as the remainder of the appendage; second joint stouter and longer than third, which is as long as the two-jointed flagellum; apical appendages twice as long as flagellum.

First peraeopods with carpus reaching level of antennal tooth; basis equal in length to remaining joints together, with a long plumose seta (reaching beyond apex of merus) at external apical angle, and two projections at inner angle, one being prominent and tooth-like (fig. 10, B^1); carpus, a little shorter than propodus, which is almost one-third as long again as the slender dactylus.

Second peraeopods stout, with basis longer than remaining joints together; ischium with a plumose seta; merus as long as carpus and propodus together, with a spine at inner apical angle and a plumose seta at outer; carpus with two subapical spines, the inner stouter than the outer, and with inner apical angle acutely produced; propodus barely more than half as long as the stout dactylus, which is equal in length to the longest of its strong apical spines.

Fossorial legs with setae short, none reaching beyond end of dactylus; basis longer or as long as rest of limb in third and fourth pairs.

Uropods long, the peduncle half as long again as telsonic somite and equal in length to the subequal rami, which are slender and tapering, with apices simple and acute; proximal half of inner margin of exopod with a row of plumose setae, that of endopod with a series of thirteen small spines, successively increasing in length, and with the last two more widely spaced than the others.

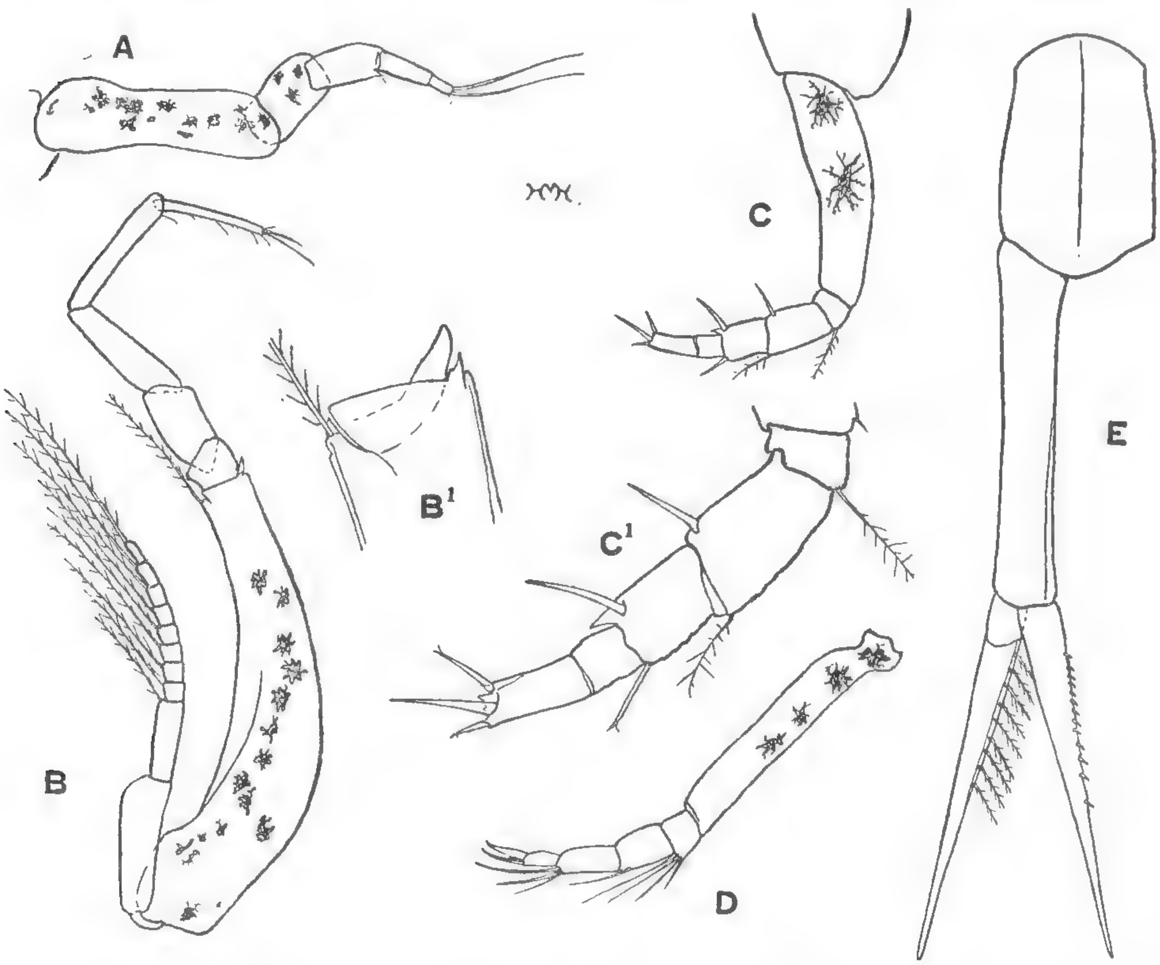

Fig. 10. *Cyclaspis fulgida*, type female; A, first antenna; B, C and D, first, second and third peraeopods; B1, distal end of basis of first peraeopod; E, telsonic somite and uropod (A, B1 and C1, × 110; B to E, × 47).

Colour white, with a pattern marked out by sooty black chromatophores, as illustrated.

Length 5·75 mm.

Loc. New South Wales: Cronulla, 8 feet (K. Sheard, submarine light, Sept. 1942). Type in South Australian Museum, Reg. No. C. 2424.

This species is rather close to *mollis,* but is readily distinguished by the following characters. The ocular lobe is relatively larger and more prominent and the eye-lenses are distinct (at least when cleared in Euparal); the antennal tooth appears more acute owing to the development of a faint ridge leading back from it. In the shorter basis of the first leg the apical inner tooth is well-developed. The second peraeopod is markedly stouter, with an inner apical spine on the merus, and the segments are of different proportions. The fossorial limbs have much shorter setae. The uropods also are distinctive.

levis group (a).

Carapace moderately compressed, the back angularly rounded; pseudorostral lobes barely meeting in front of the large or moderate ocular lobe.

Apices of both rami of uropods simple.

The three "miscellaneous" species assigned here each possess a feature of the carapace not found in any other member of the *levis* group: *strigilis* has fine striae, *sheardi* a conspicuous pit on each side alongside a median, posterior dorsal projection, while in *mjobergi* the dorsal carina is absent for the greater part of its length, although the back is angular.

CYCLASPIS STRIGILIS sp. nov.

Adult male. Integument thin and fragile, shining, with a minute squamose pattern.

Carapace with dorsal edge slightly sinuate, scarcely arched; more than one-fourth of total length of animal and almost twice as long as deep; in dorsal view

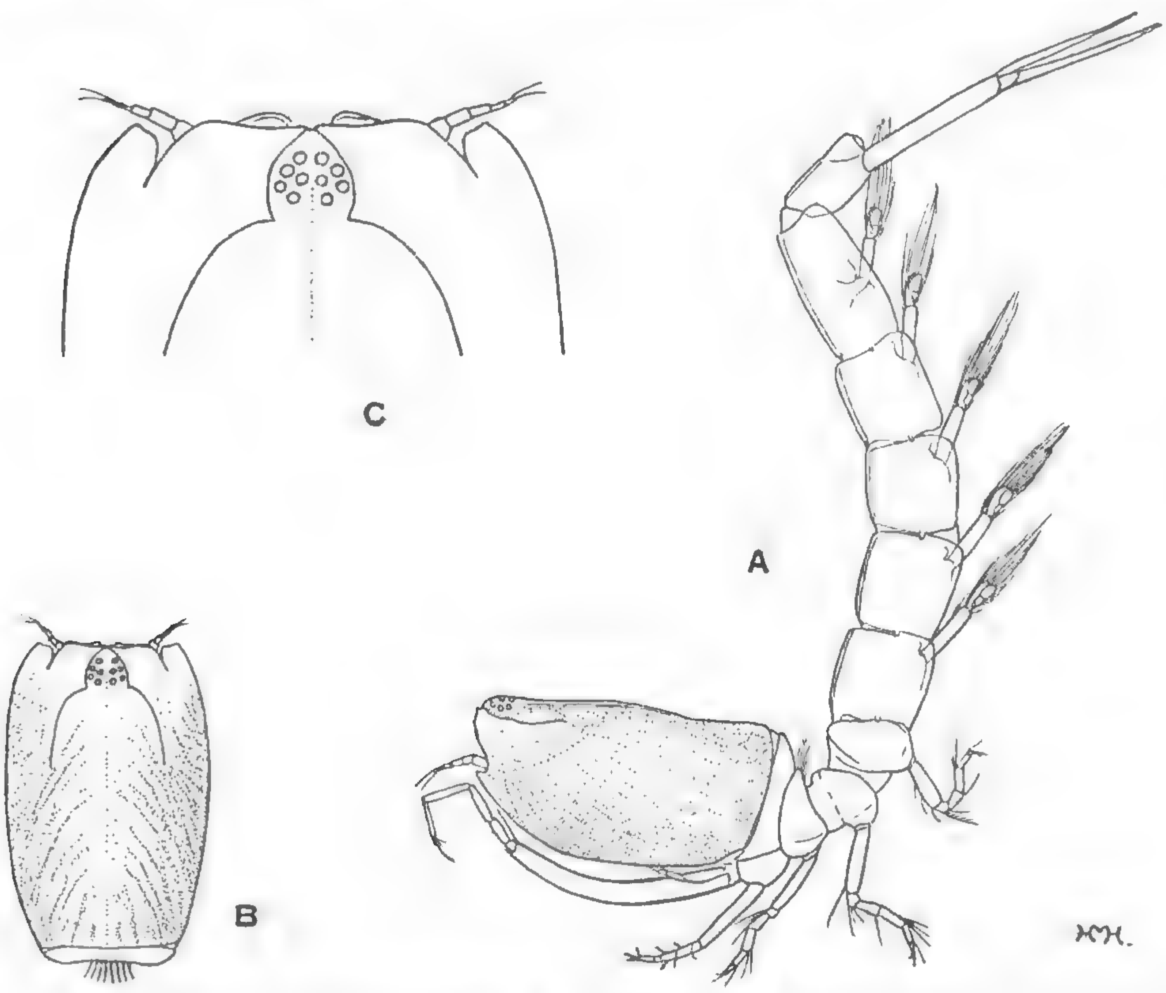

Fig. 11. *Cyclaspis strigilis*, type male; A, lateral view; B, carapace from above; C, anterior portion of carapace (A and B, × 25; C, × 60).

it is barrel-shaped, widest in anterior half, where its breadth is equal to two-thirds its length and is much greater than the depth; dorsum with a fine median carina for whole length, and sides marked with numerous oblique striae. Pseudorostral lobes not meeting in front of eye-lobe. Antennal notch rather wide and tooth distinct. Ocular lobe almost as wide as long, somewhat triangular in shape, and with ten small but distinct lenses.

Exposed pedigerous somites two, four and five with fine median dorsal carina; dorsal portion of third somite very short, sides expanded; second deep, its dorsal margin sloping steeply back from level of upper edge of carapace.

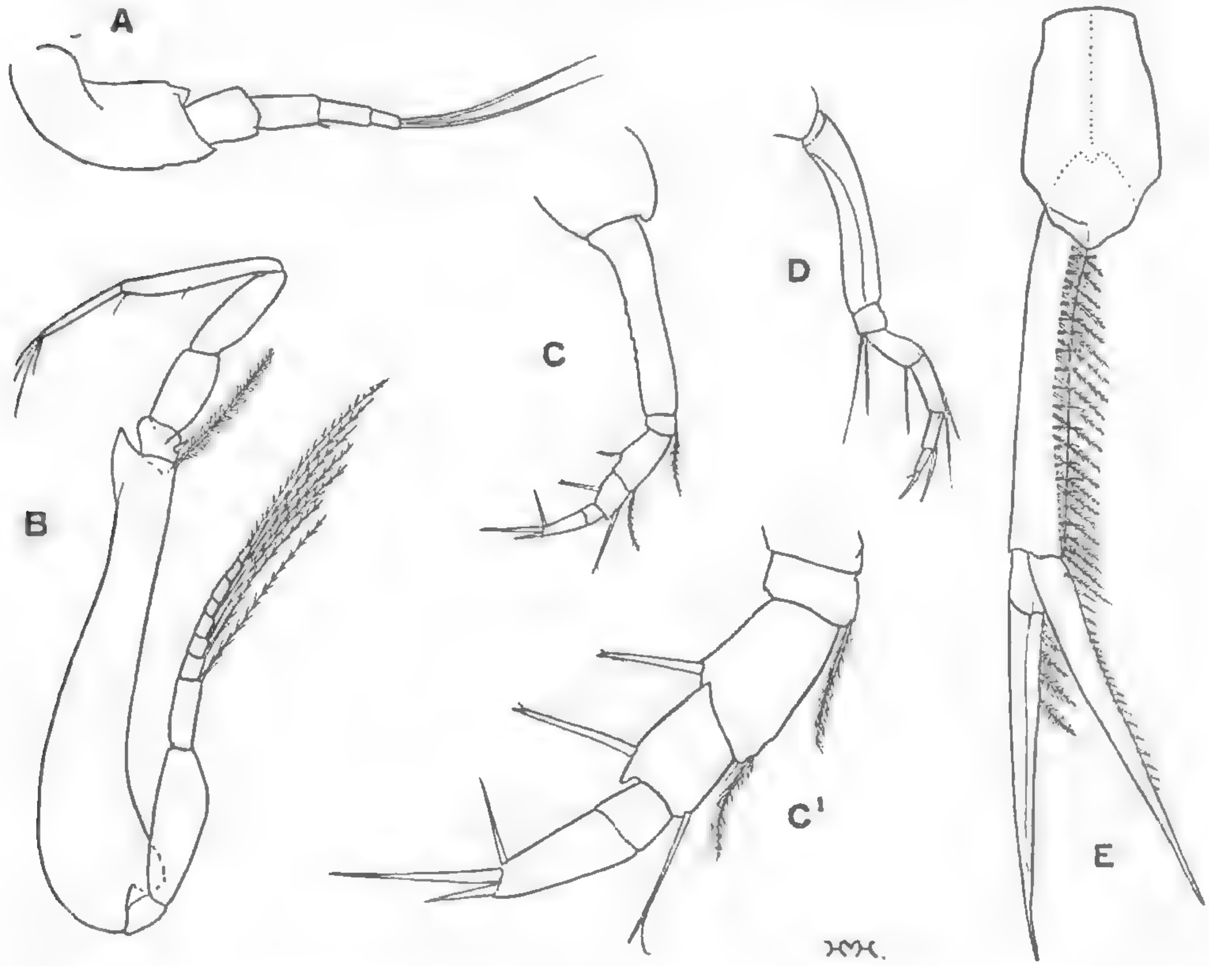

Fig. 12. *Cyclaspis strigilis*, type male; A, first antenna; B, C and D, first, second and third peraeopods; E, telsonic somite and uropod. (A, × 130; B to E, × 67; C¹, × 200).

Pleon robust, the first to fourth and telsonic somites equal in length; each somite with a fine median dorsal carina that of telsonic somite terminating at anterior end of fused telson; articular pegs small but distinct.

First antennae with accessory flagellum distinct; basal segment about as long as rest of appendage; second and third joints subequal in length, each a little shorter than the two-segmented flagellum.

First peraeopod with carpus reaching to level of antennal angle; basis barely longer than rest of limb, with inner apical angle produced and external angle with a long plumose seta, which reaches well beyond apex of merus; propodus about one-half as long again as either merus, carpus or dactylus, the last three segments not differing much in length; ischium with a short external spine, and longest terminal seta of dactylus as long as the last-named.

Second peraeopod with basis a little longer than rest of limb; ischium with a plumose seta; merus as long as carpus and propodus together, with a plumose seta and a subapical spine; carpus with two subapical spines; propodus less than half as long as dactylus, which is shorter than its longest terminal spine.

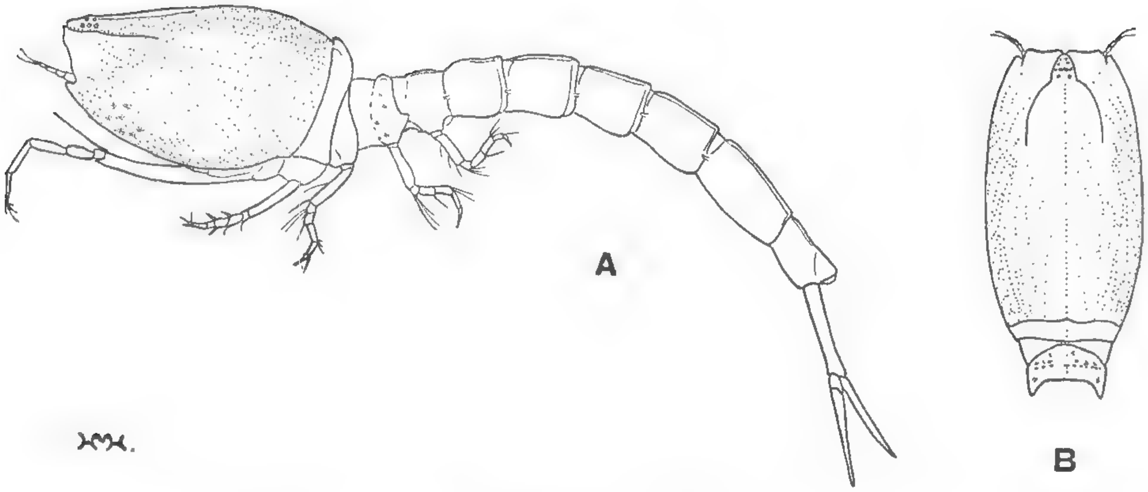

Fig. 13. *Cyclaspis strigilis,* paratype female; A, lateral view; B, carapace and anterior pedigerous somites from above (× 25).

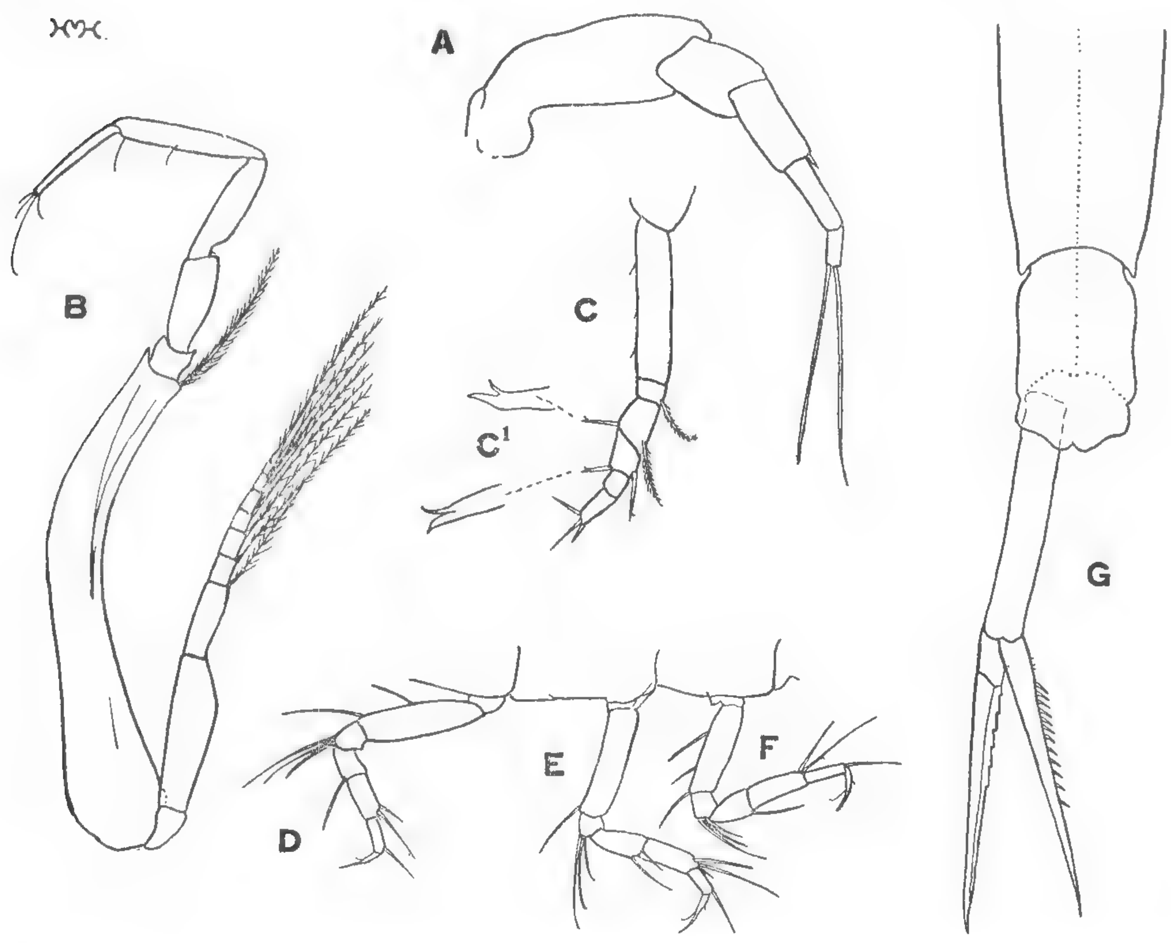

Fig. 14. *Cyclaspis strigilis,* paratype female; A, first antenna; B to F, first to fifth peraeopods; G, telsonic somite and uropod (A, × 200; B to G, × 67; C¹ × 335).

Basis of fossorial limbs shorter than remaining joints together, and carpus longer than merus; setae as in fig. 3, F.

Peduncle of uropoda half as long again as telsonic somite, its inner margin with a double row of plumose setae, those of one series twice as long as the others;

rami narrow, apically acute; endopod a little shorter than exopod, longer than peduncle, and with twenty finely serrate spines on inner edge; exopod longitudinally excavate interiorly, where the proximal third bears plumose setae, which are a little stouter than those of the peduncle.

Colourless, transparent.

Length, 4·4 mm.

Non-ovigerous female. Carapace almost one-third of total length, with striae, etc. as in male, but with dorsal edge more arched, and with length much less than twice the depth. In dorsal view it is barrel-shaped, widest at middle of length and relatively narrower than in male, the breadth being less than two-thirds the length, and equal to the depth. Thoracic appendages much as in male (fig. 14, D-F).

Peduncle of uropoda less than one-third as long again as telsonic somite, without setae; the narrow, apically acute rami are longer than the peduncle; the endopod has twelve spines on inner edge; exopod with six tiny incisions in inner margin.

Colourless except for a few brown chromatophores on carapace and fourth peraeon somite.

Length 3·6 mm.

Loc. Queensland, off Fraser Island; lat. 24° 20′ S.; long. 153° 02′ E. ("Warreen," Mar. 1938). Types in South Australian Museum, Reg. No. C. 2412–2413.

The two available specimens have the integument not at all calcified, but this may be due to a recent ecdysis; species taken with them are indurated.

CYCLASPIS SHEARDI sp. nov.

Adult male. Integument calcified, but delicate and brittle; surface finely pitted (reticulate) and with larger granules which, though about four times as wide as the reticulations, are still small and inconspicuous.

Carapace with dorsal edge very slightly arched, elevated in a distinct hump near posterior end, its depth equal to greatest width and more than half its length, which is two-sevenths of total length of animal. Pseudorostral lobes barely meeting in front of ocular lobe and with anterior margins truncate and slightly sinuate; dorsum with a median longitudinal carina, on each side of which, near the posterior end, there is a large pit; the upper edge of each pit is raised and smooth. Ocular lobe large, as wide as long and with nine prominent, darkly pigmented lenses. Antennal notch widely open; antennal tooth subacute; a faint ridge leads back for a short distance from the tooth.

The four exposed pedigerous somites together are more than half as long as carapace and each has a distinct dorsal carina; the second fits intimately against the carapace and its dorsal contour continues the hump of the back, then curves sharply down; third to fifth somites with postero-lateral angles backwardly produced in the form of rounded lobes.

Pleon relatively massive; the first three somites much deeper than the last pedigerous somite; articular processes small but distinct; first to fourth and telsonic somites subequal in length, fifth half as long again as fourth; the groove indicating the fused telson is unusually distinct; there is a distinct dorsal carina for whole length of pleon, terminating at this groove.

First antenna with basal joint of peduncle fully as long as remainder of appendage; second joint stouter than third and subequal to it, and to the two-jointed flagellum, in length; sensory terminal filaments moderately long.

Basis of second maxillipeds half as long again as remaining joints together. Third maxillipeds with basis nearly twice as long as palp and with outer distal merus reaching to level of articulation of carpus and propodus.

First peraeopod less than one-fourth as long again as carapace, the carpus reaching slightly beyond level of antennal angle; basis one-fourth longer than remaining joints together, with a long, plumose seta at outer apical angle; only a feeble suggestion of an apical tooth; merus with a small peg-like articular process at distal end; carpus half as long again as merus and barely longer than propodus; dactylus three-fifths length of propodus with two slender terminal setae, and a few insignificant hairs.

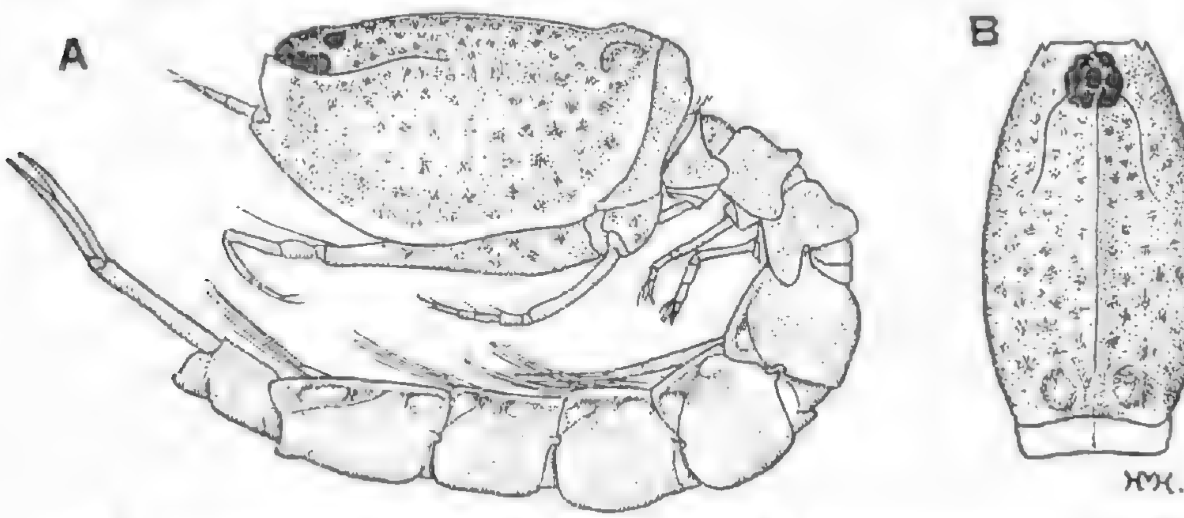

Fig. 15. *Cyclaspis sheardi*, type male; A, lateral view and B, carapace from above (× 28).

Basis of second peraeopods not quite as long as remaining joints together; merus unarmed, not as long as carpus and propodus together; carpus barely longer than dactylus, with two unequal spines (one about twice as long as the other) at outer distal angle, and one, shorter, near the inner angle, which is somewhat produced; propodus two-thirds as long as dactylus, which is a little shorter than its longest terminal spine; other two apical dactylar spines short, unequal in length.

Posterior peraeopods with two setae at outer distal angle of carpus, the longer not reaching beyond apex of dactylus.

Peduncle of uropods half as long again as telsonic somite, almost as long as fifth pleon somite and about one-fifth as long again as rami; its inner edge bears a row of long plumose setae, the distal few shorter than the others; exopod barely longer and a little narrower than endopod, with a row of plumose setae on inner margin, leaving apical third unfurnished; proximal half of inner margin of endopod occupied by a row of nine serrate spines followed by a series of seven stouter spines set in serrations, which occupy most of the distal half; apices of both rami simple and subacute.

Colour in alcohol, cream with dark brown shading and stellate markings as shown in figure. Pleon with a series of oval transparent areas.

In life the body was "vivid green with sapphire eyes and with prominent pale spots on pleon (tow-net in daylight)."

Length 5·2 mm.

Loc. South Australia: Spencer Gulf, off Wardang Island (K. Sheard, tow-net, Mar. 1938); Spencer Gulf, off Wallaroo, 5 fath. (K. Sheard, Feb. 1938); Spencer Gulf, Page Island, 9 fath., and Kangaroo Island, Antechamber Bay (K. Sheard, 1939); Spencer Gulf, Corny Point (K. Sheard 1941). Tasmania: off Cape Barren Island (D. L. Serventy, tow net, Nov. 1939). New South Wales, off Jibbon 40 metres (Cronulla Station 6, July 1943).

At all but two tow-net localities many specimens were attracted by submarine lights; all are males.

Examples taken at night were often, but by no means always, pale or light brown. The dark colour markings are variable.

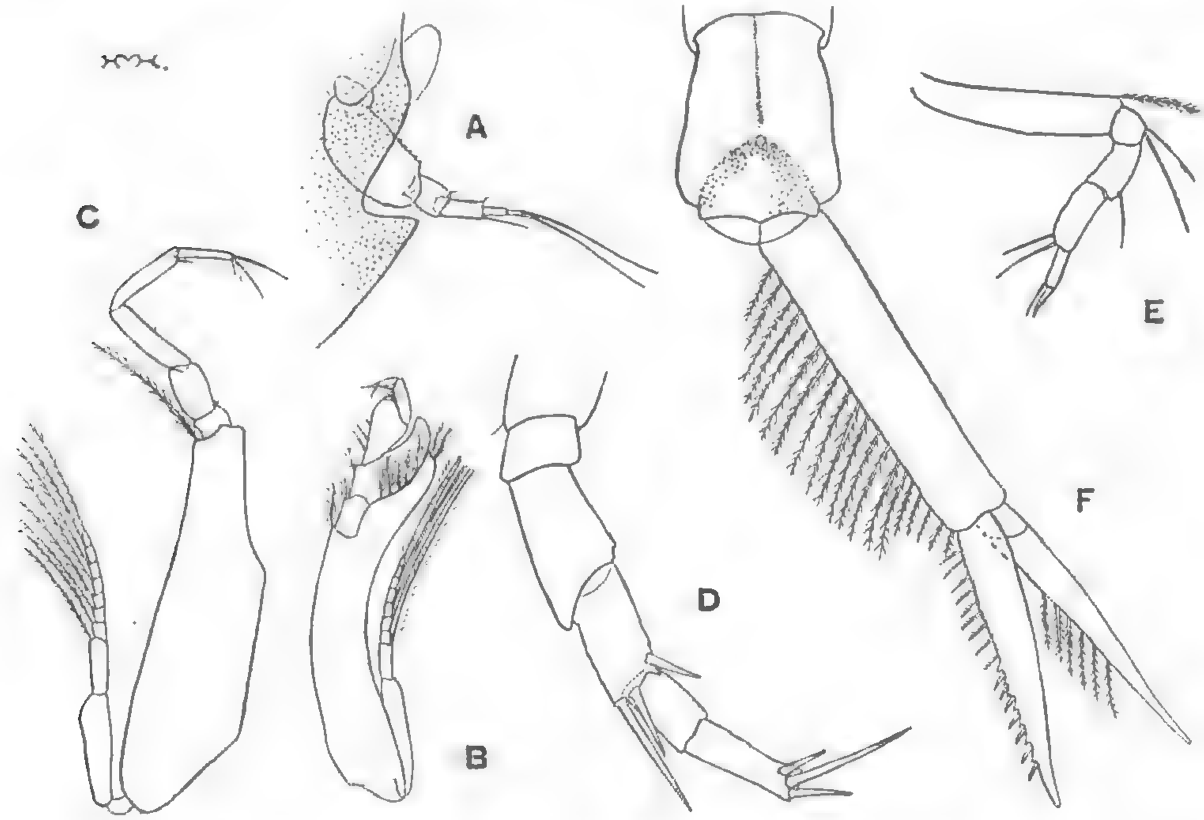

Fig. 16. *Cyclaspis sheardi*, paratype male; A, first antenna and antennal notch; B, third maxilliped; C, D and E, first, second and third peraeopods; F, telsonic somite and uropod (A, E and F, × 64; B, × 36; C, × 40; D, × 110).

The salient features of *sheardi* are the pits near the posterior end of the carapace, the large and prominent eyes, the relatively massive carapace and pleon, and the well marked groove indicating fusion of telson and preceding somite.

It is with much pleasure that I name this pretty species after Mr. Keith Sheard, who has proved an able and enthusiastic collector of Australian Cumacea.

CYCLASPIS MJOBERGI Zimmer.

Cyclaspis mjobergi Zimmer, 1921, p. 11, fig. 14-16.

A large number of males from South Australia seem, with little doubt, to be referable to this species which, as noted by Zimmer, is separated from related members of the genus, having no pseudorostrum and no ridging of the carapace, by the absence of a complete median dorsal carina on the carapace. The specimens now in hand have the surface pitting, the carinae and obsolete carinae, as described for the types but the size is considerably smaller, the anterior margin of the carapace below the antennal notch is more oblique and the uropods are of different proportions. In these appendages the peduncle is about three-fifths as long as the telsonic somite, and the rami are certainly not a little shorter than the peduncle,

but are more than one-third as long again; further, the inner margin of the exopod bears long plumose setae.

The following details may be noted also:

Ocular lobe almost twice as long as wide, broadest anteriorly, where the five lenses are large and pigmented. First antenna with basal joint of peduncle one-third as long again as second, which is equal in length to third; flagellum two-segmented with two terminal appendages.

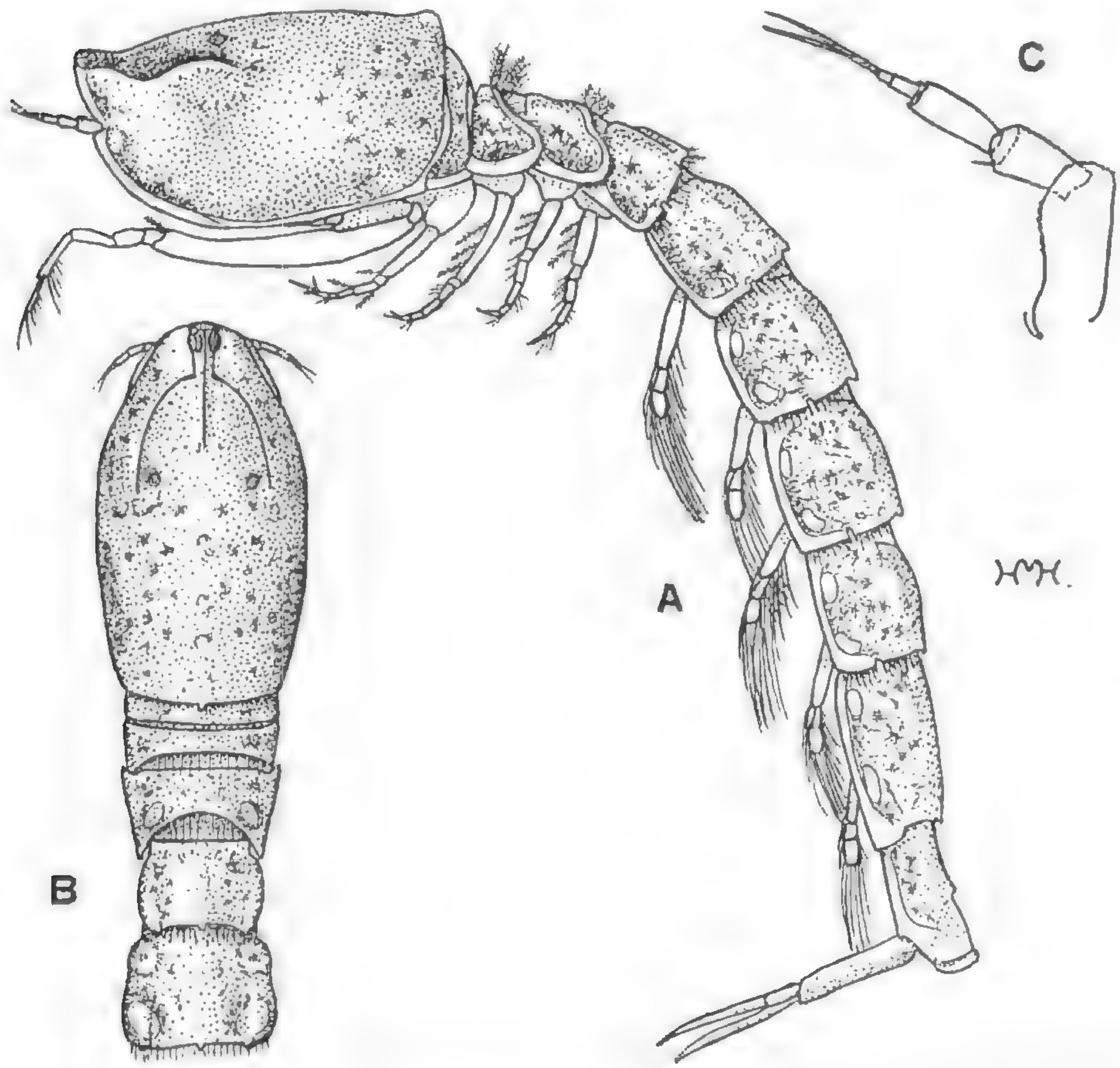

Fig. 17. *Cyclaspis mjobergi*, adult male; A, lateral view; B, cephalothorax and first pleon somite from above; C, first antenna (A and B, × 18; C, × 84).

Third maxillipeds stout; basis widened and produced forwards at apex, the lobe reaching a little beyond middle of length of merus and with plumose setae on anterior edge; merus almost as long as carpus and propodus together, expanded externally to form a wide rounded lobe; dactylus as long as propodus, carpus wider and slightly longer.

First peraeopods with basis long, fully half as long again as remaining segments together, and bearing a plumose seta at outer apical angle; carpus longer than dactylus and five-sixths as long as propodus, which is longer than ischium and merus together.

Basis of second peraeopods slightly longer than remaining joints together; merus as long as carpus and propodus combined and a little longer than dactylus, which is shorter than its longest apical spine; basis, ischium and merus with an apical plumose seta.

Basis of third to fifth legs with long plumose setae; basis of third and fourth as long as rest of limb, of fifth shorter; merus and carpus of these peraeopods subequal in length; for setae see fig. 3, K, and 18, D.

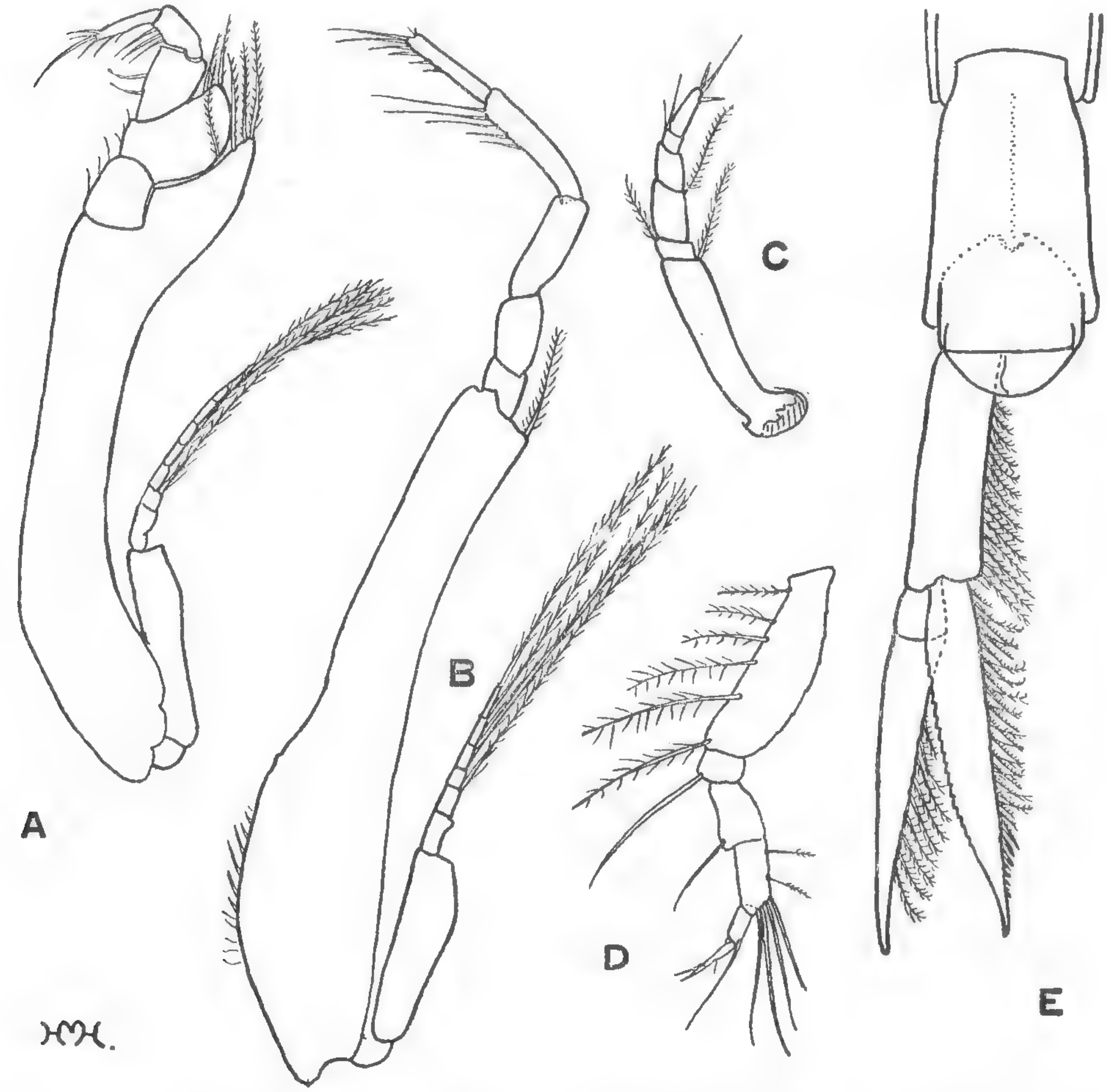

Fig. 18. *Cyclaspis mjobergi*, adult male; A, third maxilliped; B to D, first, second and fourth peraeopods; E, telsonic somite and uropod (× 50).

The carapace is slightly tumid beneath the posterior half of each pseudorostral suture. There is a distinct short median longitudinal carina anteriorly only; it ends abruptly at the middle of length of frontal lobe.

The colour pattern is variable. Some specimens are darkly pigmented, with large chromatophores as shown in fig. 17, A; others are grey with few or no darker spots. Often, but not always, the anterior portion of the carapace is markedly lighter, with conspicuous demarkation.

Length 8 mm. to 9 mm.

Loc. South Australia: St. Vincent Gulf, Brighton (Patricia Mawson and L. M. Angel, Oct. 13, 1941, 8.15 to 8.30 p.m.; Oct. 22, 1941, 9.30 to 9.45 p.m., and Nov. 13, 1941, with submarine light traps.)

Hab. North-Western Australia and South Australia.

This record considerably extends the known range of the species. It is of interest that despite years of collecting in St. Vincent Gulf, *mjobergi* was not taken until males swarmed on two separate dates in shallow water (the specimens were secured from a jetty). In the first haul a "white" submarine light of low candle-power was employed and over two thousand examples were found in the net after an immersion of fifteen minutes; a few individuals of other Cumacea and some Amphipods were also present. Nine days later the same procedure was adopted with a green light and about seven hundred specimens congregated in the net in fifteen minutes. As before all were males of almost uniform size. In a third haul three weeks after this only a few males were found. The collectors used red submarine light at the same time as the green. Amphipoda predominated in the red light-trap but the reverse obtained in the green.

levis group (b).

Carapace compressed, particularly in male and subadult female, the sides rising steeply to the sharp median carina of the back; pseudorostral lobes truncate anteriorly, barely or not meeting in front of the ocular lobe, which is large, with prominent lenses.

Apices of both rami of uropods simple.

Four Australian species, if Foxon's Queensland record for the New Zealand *levis* is correct; it is assumed herein that the last-named has all the above characters.

CYCLASPIS LEVIS Thomson.

Cyclaspis levis Thomson, 1892, p. 264, pl. xvi, fig. 1–6, and pl. xvii, fig. 7–26; Foxon, 1932, p. 389.

With a score of species clustering, as it were, around this form, it is unfortunate that it is insufficiently diagnosed and that it has not been rediscovered without doubt during the past half century. The group name is retained because *levis* has been so often referred to.

It may be assumed that Thomson's interpretation of the ocular lobe and its lenses (his specimens were from surface and shallow water) is as improbable as the dramatic apical projection of the basis of the first peraeopods which he illustrates (Calman, 1907, p. 9). Venturing further, and supposing that the rest of Thomson's description and figures are reasonably accurate, then *cretata, granulosa, concinna, formosae* and *herdmani* fall naturally into place beside it. If *levis* really possesses an apical tooth (of more reasonable size than described) on the basis of the first legs, then *concinna* is removed from the list. In any case, *cretata* seems to be closest to *levis* but is distinguished by the more numerous and shorter spines on the inner edge of the endopod of the uropod where there are no slender setae as figured by Thomson (see key to species); *pura* has uropods similar to those shown for *levis.*

Stebbing (1913, p. 32, *syn.)* queries Calman's reference of some New Zealand specimens to *levis* and that author himself expressed uncertainty. The provisional name *calmani* is herein proposed for these examples.

Foxon more recently records *levis* from north-eastern Queensland, but no details concerning his material are given.

CYCLASPIS CRETATA sp. nov.

Adult male. Integument thin, calcified but somewhat flexible; glossy, with fine reticulate pattern and very small pitting.

Carapace with dorsal edge only slightly arched, two-sevenths of total length of animal, and twice as long as deep; moderately compressed, its width equal to depth; there is a thin, median longitudinal carina for anterior half of length, flanked on each side by a distinct depression, the posterior termination of which is marked by a slight but evident emargination of the dorsal edge as seen from the side; posterior to this the carina is much less distinct (really a narrow, depressed area with a somewhat bifurcate appearance); there is a faint depression on each

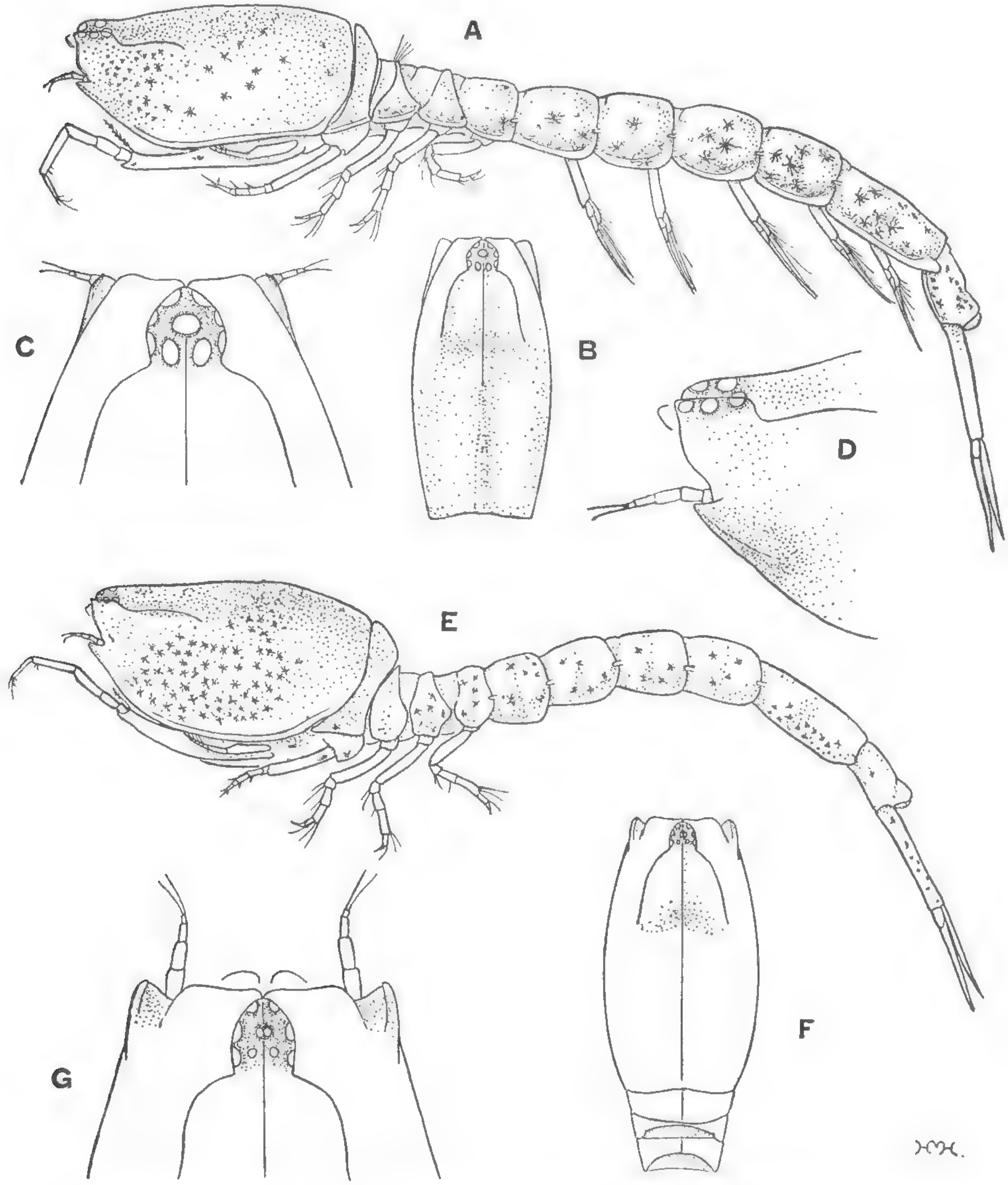

Fig. 19. *Cyclaspis cretata*, type male; A, lateral view; B, carapace from above; C and D, upper and side views of frontal portion of carapace. Allotype female; E, lateral view; F, carapace and anterior pedigerous somites from above; G, anterior portion of carapace (A, B, E and F, × 20; C, D and G, × 40).

side below the pseudorostral suture and behind the dorso-lateral excavations are faint indentations, lending a suggestion of a coarse squamose pattern. Antennal notch moderately wide, with a very faint short groove leading back from it; a short rounded ridge runs back from the narrowly rounded antennal tooth, giving it a subacute appearance. Pseudorostral lobes truncate and slightly sinuate in front, barely meeting in front of ocular lobe. Ocular lobe wide, constricted at base, roundly subtriangular, as wide as long, and with nine prominent lenses; strongly pigmented.

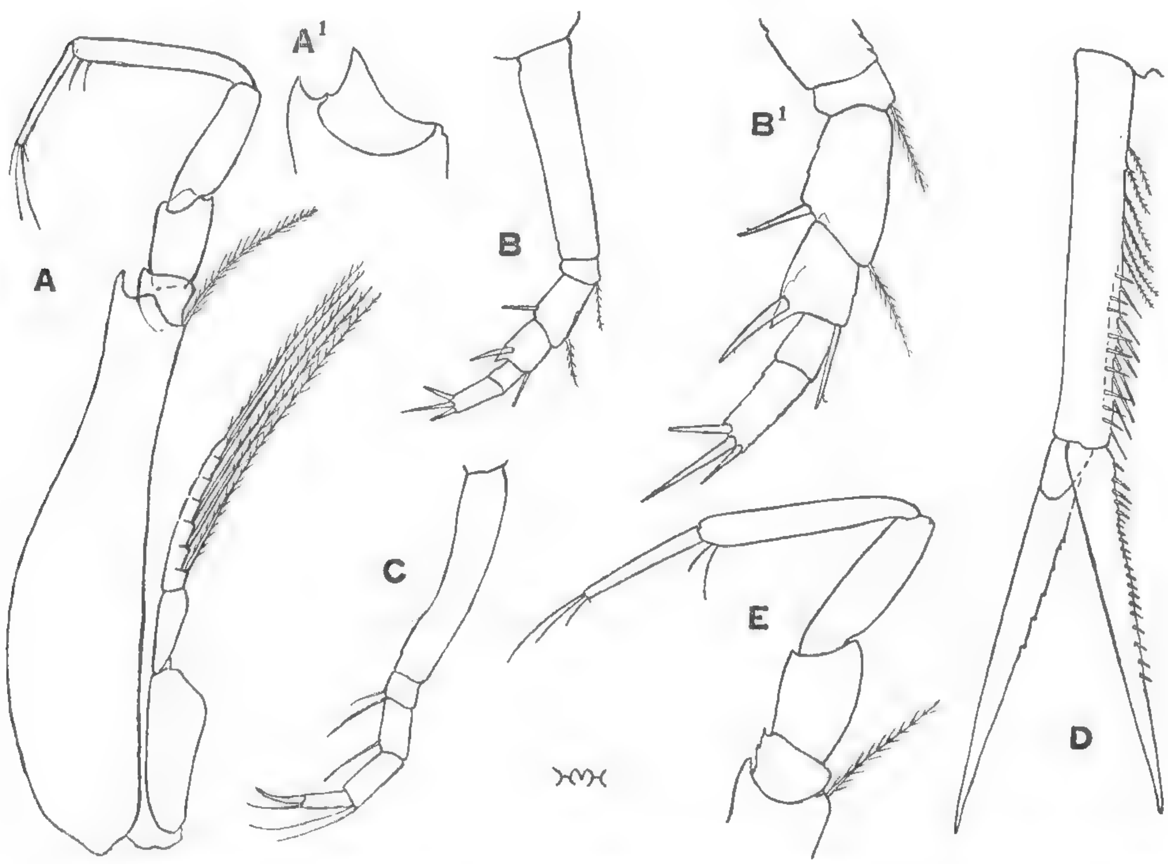

Fig. 20. *Cyclaspis cretata*, paratype male; A, first peraeopod and A1, distal end of its basis; B and B1, second peraeopod; C, third peraeopod; D, uropod. E, Terminal joints of first peraeopod of allotype female (A to E, × 67; A1 and B1, × 134).

The four exposed pedigerous somites together are much more than half the length of the carapace; each has a faint median longitudinal carina; dorsal edge of second slightly rounded, descending steeply from the level of the hinder edge of carapace; third and fourth with the usual lateral subtriangular area distinctly delineated, each as long as the slightly expanded pleural portions of second.

Pleon somites each with a fine, thin ridge; somites one to five with obsolete dorso-lateral carinae and (like fifth peraeon somite) with the sides tumid fore and aft, a shallow groove between the elevations; articular processes small but distinct; first four and telsonic somites equal in length; telsonic somite with dorsal notch moderate.

First antenna with second segment almost as long as third, and stouter, the two together much shorter than the basal segment.

First peraeopod with carpus just reaching level of antennal tooth; basis barely longer than rest of limb, its apex with a long exterior plumose apical seta (reaching beyond distal end of merus) and with two tooth-like projections, the

inner not quite attaining distal end of ischium (fig. 20, A^1); propodus one-fifth as long again as carpus and fully half as long again as dactylus, which is longer than its longest terminal seta.

Basis of second peraeopod as long as rest of limb; ischium with an outer plumose seta; merus longer than carpus and propodus together and as long as propodus and dactylus together, with a strong spine at inner distal angle, and an outer plumose seta; carpus with a stout spine inserted near the acute, tooth-like apical inner angle, and a more slender outer spine; propodus barely more than half length of dactylus, which is shorter than its longest terminal spine.

Fossorial legs with the setae short (fig. 3, F); merus and carpus subequal in length; basis of third as long as rest of limb.

Peduncle of uropods about one-third as long again as telsonic somite and as long as exopod; inner margin with half a dozen plumose setae on proximal portion, followed by about the same number of slender spines, set above which is a row of shorter spines; both rami with apex simple and narrowly acute; exopod a little longer than endopod, with half a dozen incisions in inner margin, endopod with five slender serrate proximal spines on inner margin, followed by a row of sixteen shorter and stouter spines of slightly different type, the series ending at about second third of length.

Colour chalky white, with sooty stellate markings and faint blackish mottling.

Length 6 mm.

Adult female (developing marsupium). Differs from male as follows. The carapace is a little wider and deeper, and is larger, almost one-third of the total length. The ocular lobe is slightly narrower, so that it appears less constricted basally; the lenses are smaller and less distinct, the median one seemingly formed of two components. The exposed pedigerous somites together are less than half as long as the carapace and the dorsal edge of the second slopes downwards less steeply.

In the first peraeopods the propodus is relatively a little longer, one-fourth as long again as merus and one and three-fourths times as long as dactylus.

The uropods are of the same proportions, but the peduncle lacks setae and spines; the proximal spines of the inner edge of the endopod are followed by a row of fifteen short spines, which increase gradually in length as in the male.

Length 5·3 mm.

Loc. New South Wales: Cronulla, 8 feet (K. Sheard, submarine light, Sept. 1942, 8 to 8.20 p.m.) Types in South Australian Museum, Reg. No. C. 2418.

A single female and several adult males are availabe. The spines on the inner margin of the endopod show some variation—three to six proximal spines followed by fifteen to twenty-three shorter ones.

South Australian form of cretata. Adult males differ from the examples described above as follows:

The dactylus of the first peraeopods is relatively a little longer (the propodus not quite half as long again as it); the basis is longer than the rest of the limb. The uropods are as in *granulosa* with a wide fan of inner plumose setae on the peduncle and with plumose setae on the inner edge of the exopod.

Colour chalky white; sparse black dots sometimes present.

Length 4·2 mm. to 6 mm.

Loc. South Australia: Spencer Gulf, Memory Cove, 3 fath., weedy bottom (K. Sheard, Feb. 1941, 8 to 8.30 p.m.), and Page Is., 9 fath., 7 to 7.30 p.m.; 7 fath., 8 to 8.30 p.m. (K. Sheard, Apl. 1941); Kangaroo Is., Antechamber Bay, 4 fath. (K. Sheard, Apl. 1941, 8 to 8.30 p.m.). Types in South Australian Museum, Reg. No. C. 2366, 2368, 2370 and 2371.

Many specimens were secured by a submarine light; it seems undesirable to accord these examples specific rank.

Salient features of *cretata:* The carapace has the anterior depressions appreciably developed and there is a small emargination in the dorsal profile at their posterior end. The propodus of the first peraeopods is obviously longer than the carpus or dactylus and the basis has an apical tooth. The uropods have long peduncle and long, simple and acute rami, the endopod with a row of many small spines, and a few proximal spines of different type.

CYCLASPIS GRANULOSA sp. nov.

Adult male. Integument thin but brittle, finely reticulate.

Carapace in lateral view with dorsal margin almost straight, slightly convex; approximately two-sevenths of total length of animal; slightly wider than

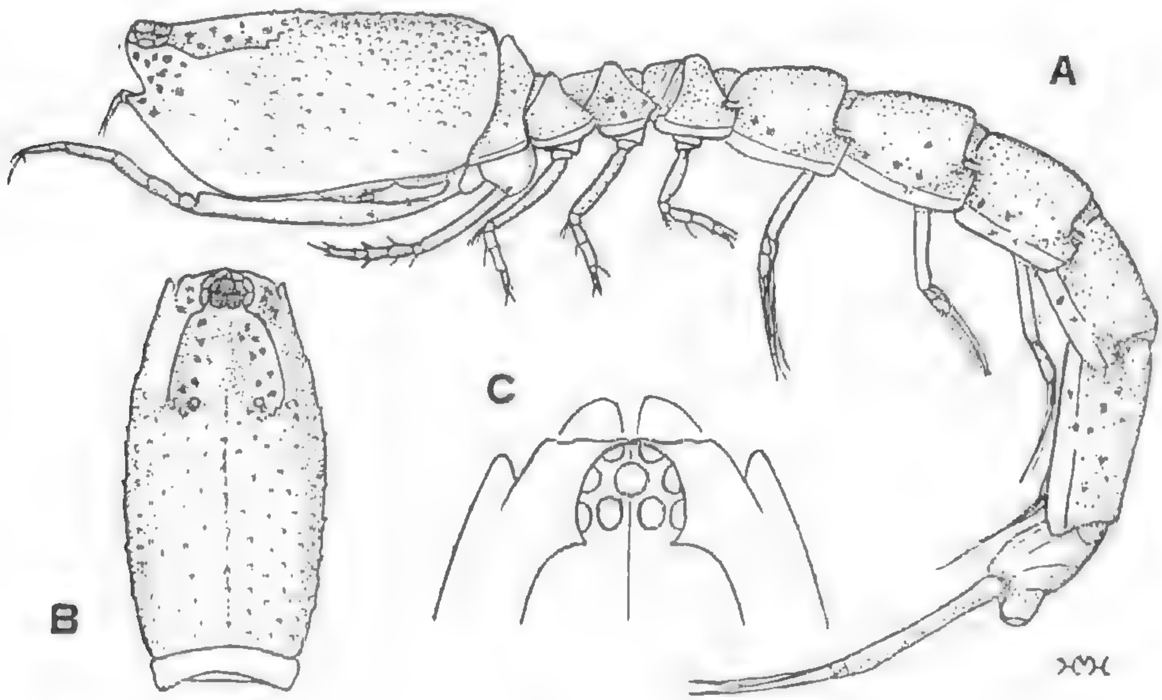

Fig. 21. *Cyclaspis granulosa,* type male; A, lateral view; B, carapace from above. C, Anterior portion of carapace of paratype male (A and B, × 23; C, × 50).

depth, which is one-half of length; surface rather sparsely but conspicuously granulose, particularly in posterior portion; dorsum with an oval depression on each side immediately behind ocular lobe and between carinate mid-line and pseudorostral suture; posterior limit of excavations marked by a very slight emargination of dorsal profile. Pseudorostral lobes reaching to level of apex of ocular lobe but barely meeting in front of it. Ocular lobe rounded, constricted at base, almost as wide as long; nine large lenses, the median three amber, the lateral ones transparent. Antennal notch wide and antennal tooth acute.

Pedigerous somites two to five exposed, each with a median carina, together two-thirds as long as carapace; second somite with dorsal margin sloping sharply down and backwards; third to fifth with triangular lateral area well-defined.

Pleon somites each with a low median dorsal carina; somites one to five with slender articular pegs; first to fourth and telsonic somites subequal in length

First antenna with the stout basal segment almost as long as the rest of the appendage, without the terminal sensory setae.

Third maxillipeds with basis strongly curved, twice as long as rest of limb, and with outer apical lobe extending forward to level of insertion of carpus; ischium and carpus subequal in length and merus half as long again, with outer apical lobe extending to insertion of propodus.

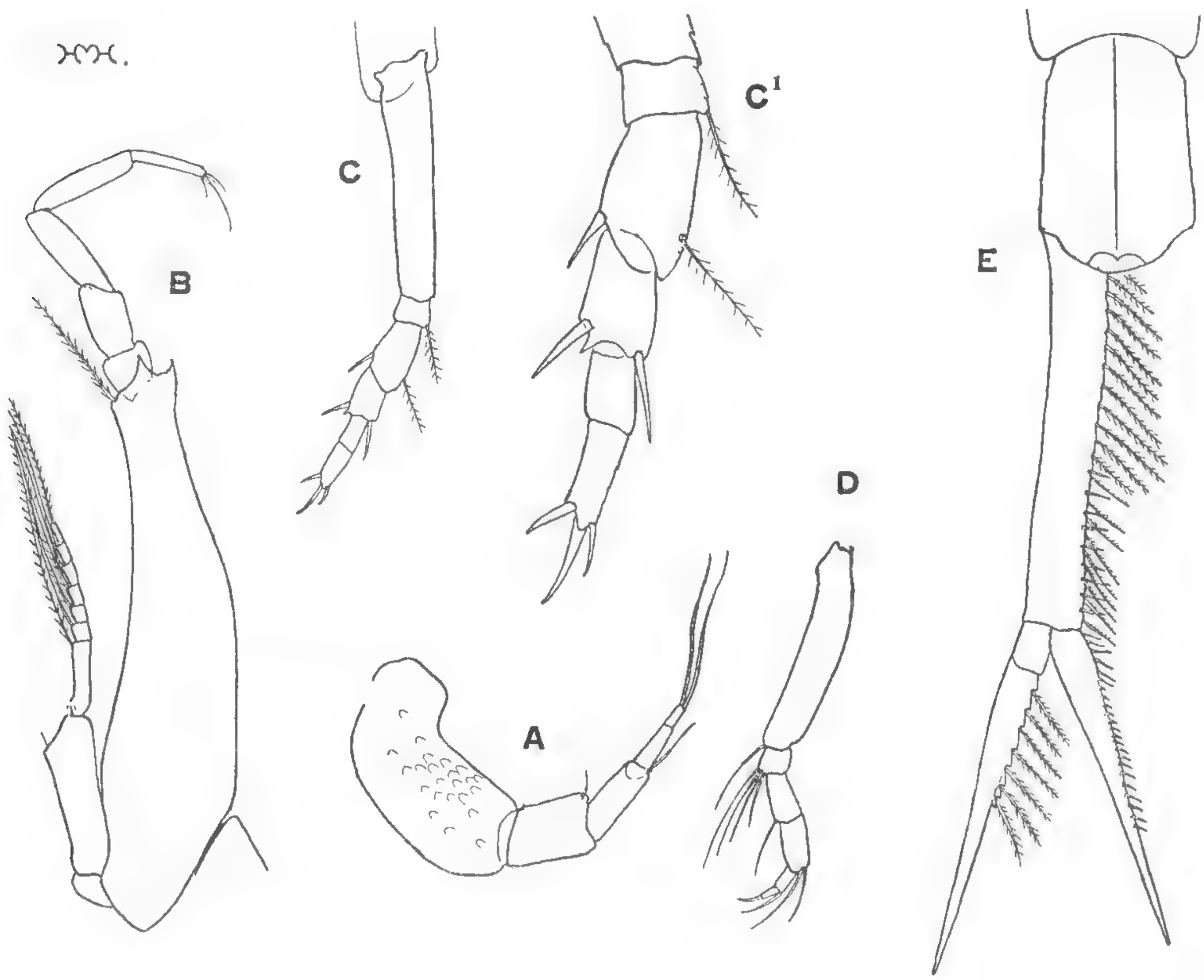

Fig. 22. *Cyclaspis granulosa*, paratype male; A, first antenna; B to D, first, second and third peraeopods; E, telsonic somite and uropod (A and C1, × 120; B to E, × 53).

First peraeopod with carpus reaching to level of antennal tooth; basis nearly half as long again as rest of limb, its apex with two tooth-like projections (the inner not reaching distal margin of ischium) and with a plumose seta at external angle; propodus equal in length to carpus and more than half as long again as dactylus, which is as long as longest terminal seta.

Basis of second peraeopod a little longer than rest of limb; ischium with an outer apical plumose seta; merus shorter than carpus and propodus together, with a stout spine at inner distal angle, and a plumose, subapical seta on outer margin; carpus subequal in length to dactylus, with a strong spine inserted near the tooth-like inner apical angle and a more slender outer apical spine; propodus three-fourths as long as dactylus, which is equal in length to the longest of its robust, slightly curved, terminal spines.

Fossorial legs as in *C. cretata* with the apical seta of the carpus stout.

Uropods long, the peduncle more than half as long again as telsonic somite; inner edge with a row of long plumose setae on proximal half; these are followed by a series of more slender plumose setae and a parallel row of shorter slender spines; exopod a little longer than endopod and almost as long as peduncle, with a row of seven plumose setae on inner edge, leaving posterior half unfurnished; inner margin of endopod with six slender spines near base, followed by a row of seventeen small short spines, increasing gradually in length backwards, but leaving the distal third of the ramus unarmed.

Colour white, with brown chromatophores on the anterior dorsal depressions of carapace, the pseudorostral lobes, the fourth pedigerous and first five pleon somites.

Length 6·45 m.m.

Loc. South Australia: Waterhouse Bay, east end of Thistle Is., 8 to 8.30 p.m., and Dangerous Reef, 4 fath., 8 to 8.30 p.m. (K. Sheard, submarine light, Mar. 1941). Type in South Australian Museum, Reg. No. C. 2328.

Only males were secured. As with other similar forms taken after dark it is probable that the colour pattern is more apparent in daytime. The spines on the inner margin of the endopod vary little in the available material, five to six proximal slender spines followed by a series of sixteen to seventeen. *C. granulosa* is rather close to *cretata*, particularly to the South Australian form of the last-named, but the roughened appearance of the carapace, due to the granulation, cannot pass unnoticed, while the propodus of the first peraeopods, when the two species are placed side by side, is easily seen to be relatively shorter.

CYCLASPIS CONCINNA sp. nov.

Adult male. Integument as in *pura*. A fine sharp median carina on carapace, exposed pedigerous, and pleon somites.

Carapace with dorsal margin slightly and evenly arched from rear to base of ocular lobe; two-sevenths of total length of animal and with its depth much more than half its length; narrow, the width considerably less than depth and less than half the length. Antennal notch moderately deep, with a short shallow groove running back from it; antennal tooth subacute without antennal ridge. Pseudorostral lobes reaching apex of ocular lobe but barely meeting in advance of it. Ocular lobe subtriangular, rounded anteriorly and constricted at base; as wide as long and with nine large lenses.

Exposed pedigerous somites together more than half as long as carapace; second somite rather short with dorsal edge sloping steeply down from dorsal contour of carapace.

Pleon as in *pura*.

Third maxilliped with basis twice as long as remaining joints together, and with a long narrow apical lobe, one-third as long as rest of basis and capped with plumose setae; merus longer than carpus with a wide lobe reaching level of apex of latter; ischium relatively long subequal in length to the carpus, which is widest anteriorly and as long as propodus and dactylus together.

First peraeopod with carpus not reaching level of antennal angle; basis more than half as long again as rest of limb, with inner apical angle rounded, barely produced, there being present only a minute tooth; external angle with a long plumose seta, reaching beyond middle of length of carpus; carpus a little longer than propodus, which is distinctly longer than dactylus.

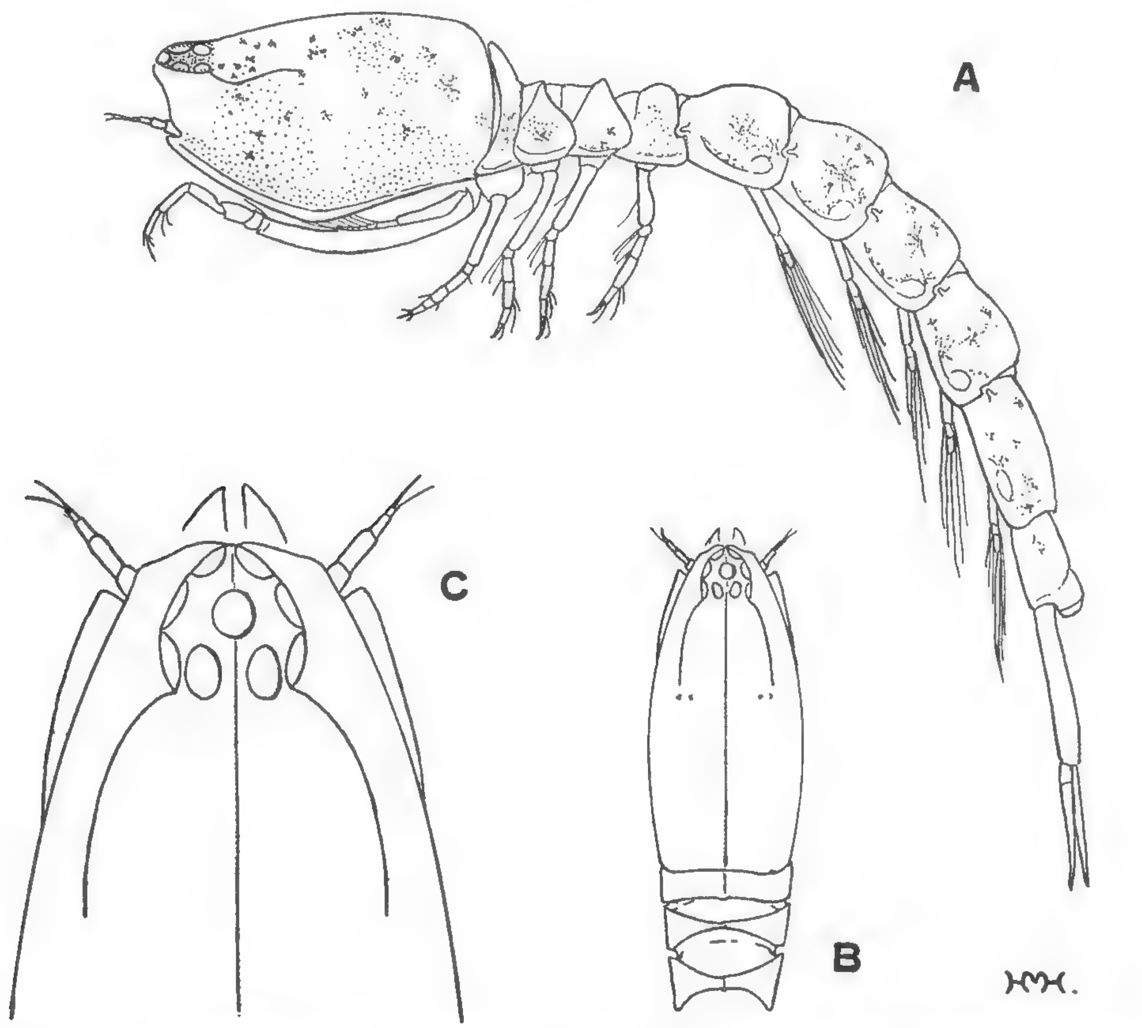

Fig. 23. *Cyclaspis concinna*, type male; A, lateral view; B, carapace and anterior pedigerous somites from above; C, anterior half of carapace (A and B, × 30; C, × 82).

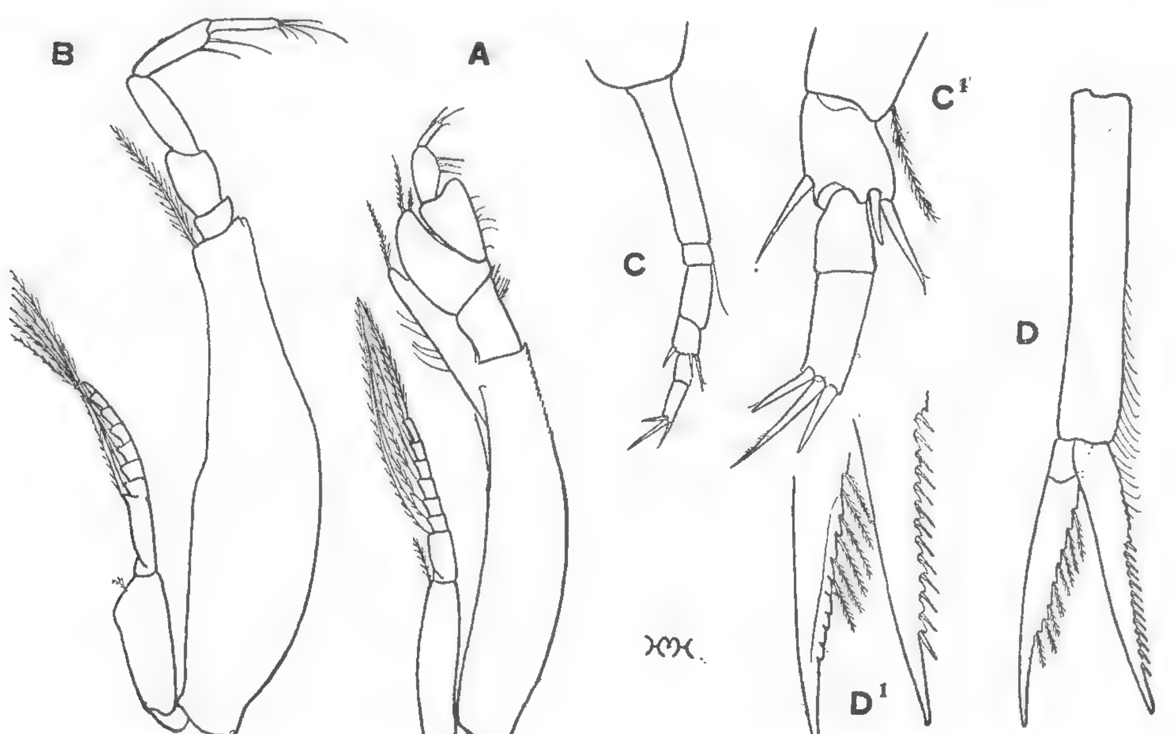

Fig. 24. *Cyclaspis concinna*, paratype male; A, third maxilliped; B and C, first and second peraeopods; D, uropod; D1, distal half of rami of uropod (A to D, × 67; C1 and D1, × 134).

Basis of second peraeopods as long as rest of limb; merus subequal in length to carpus and propodus together, and to propodus and dactylus together; carpus with three spines; propodus two-thirds as long as dactylus, which is equal in length to the longest of the stout terminal spines.

Setae of fossorial limbs as in *pura*, fig. 3, F.

Peduncle of uropoda about one and one-half times as long as telsonic somite, and one-fourth as long again as endopod, with marginal setae; exopod with eight plumose setae set in serrations on inner margin; endopod a little shorter than exopod, its inner margin with setae on proximal third and thence with a row of thirteen short and rather slender spines. Both rami narrow, the subacute apices without terminal spines or mucrones.

Colour white, with smoky patches and large black chromatophores.

Length 5 mm.

Loc. New South Wales: Cronulla, 8 feet (K. Sheard, submarine light, Sept. 1942, 8 to 8.20 p.m.) Type in South Australian Museum, Reg. No. 2423.

Only males were taken. They are similar to the males of *pura*, but are separated by the following characters: The carapace lacks a faint antennal ridge and the dorsal margin of the second pedigerous somite is more oblique. The first peraeopods have the segments of different proportions, the basis being relatively longer, and the dactylus shorter. The dactylus of the second peraeopods has stouter and slightly shorter terminal spines. The uropods are very different, the exopod having no terminal mucrones, and the endopod being furnished with a long row of many more and shorter spines.

levis group (o).

Carapace not at all compressed, almost globose, the back broadly rounded, with very fine but distinct median carina; pseudorostral lobes barely meeting in front of the rather small ocular lobe.

Apices of both rami of uropods simple.

A *pusilla*-like assemblage limited to four species.

CYCLASPIS GLOBOSA sp. nov.

Subadult female. Integument indurated, with coarse, clear-cut reticulation.

Carapace almost globose, one-third of total length of animal, and overhanging the pedigerous somites, so that, seen from above, the second and all but the lateral portions of the third are hidden by it (fig. 25, B); widest at the middle of its length, where it is slightly broader than vertical depth, which is equal to three-fourths of the length; dorsum with a fine, unbroken, median carina for whole length. Antennal notch deep and not widely open; antennal tooth large, subacute. Pseudorostral lobes just meeting in front of eye-lobe, truncate in front. Ocular lobe moderately large, subtriangular, slightly longer than wide, not constricted at base and with colourless lenses at sides and apex.

Four pedigerous somites exposed; together they are more than half as long as the carapace, the second somite is not longer than the others and its short dorsal margin (as seen from the side) slopes sharply down from the carapace, which bulges above it; each somite with a median carina for whole length.

Pleon longer than thorax, slender; each somite swollen and with a fine median carina but no other sculpture; first to fourth and telsonic somites subequal in length; articular pegs small but much more distinct than in *clarki*.

First antennae with basal joint of peduncle long, almost equal in length to remaining joints together.

First peraeopods with carpus reaching level of antennal tooth; basis one-fourth as long again as rest of limb, the apex with an external, plumose seta, and

with an apical tooth, which reaches to beyond middle of length of ischium; carpus only slightly shorter than propodus, which is distinctly less than half as long again as dactylus.

Second peraeopods about as long as second to fifth, but stouter; basis a little longer than rest of limb, with plumose setae on inner face; ischium with a plumose seta at outer angle; merus almost as long as carpus and propodus together and with an outer apical plumose seta twice as long as carpus; carpus with two stout, unequal spines; propodus two-thirds as long as dactylus, the longest terminal

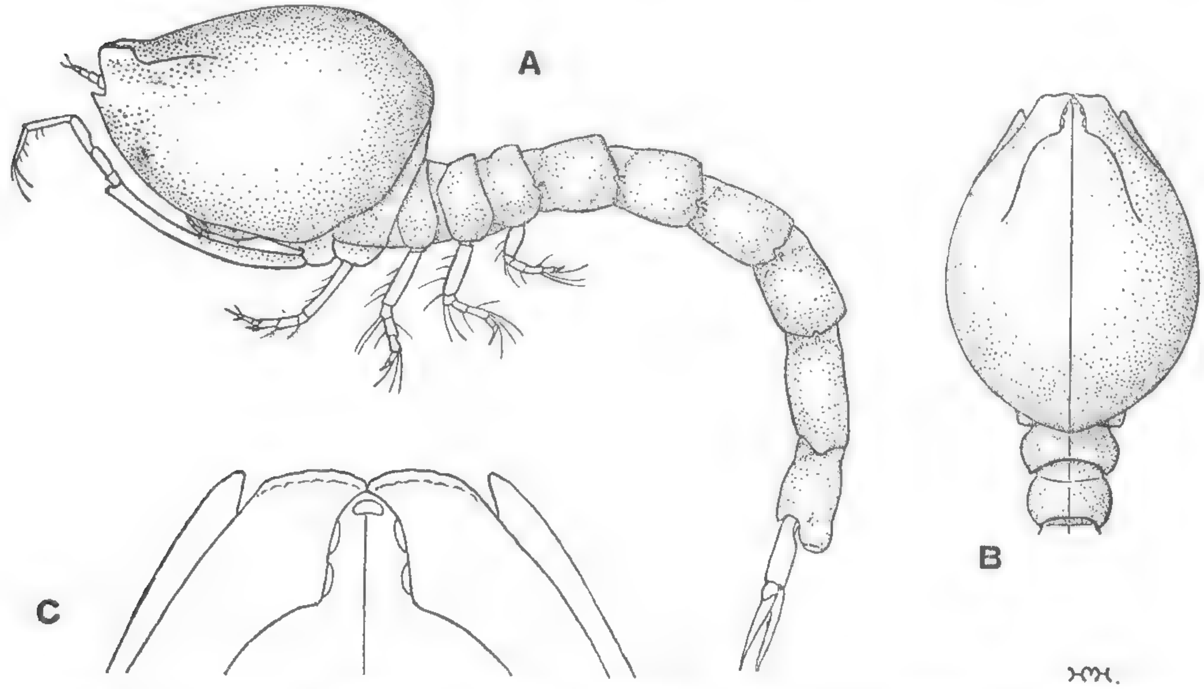

Fig. 25. *Cyclaspis globosa*, type female; A, lateral view; B, cephalothorax from above; C, anterior portion of carapace (A and B, × 15; C, × 40).

spine of which is as long as the merus; the other two spines of the dactylus are unequal, one being one-half, the other only one-fourth, the length of the longest.

Third to fifth peraeopods with merus and carpus subequal in length; carpus with three setae at distal outer angle, longest and propodal seta reaching well beyond apex of dactylus (fig. 3, A and J).

Peduncle of uropoda stout, about two-thirds length of the subequal rami, which are as long as the telsonic somite, and are wide, with simple, narrowly rounded apices; distal half of inner margin of exopod with a few plumose setae, that of exopod serrate.

Colour white.

Length 7 mm.

Juvenile female. Antennal notch a little more widely open than in the older female. Carapace fully as globose and overhanging posteriorly. Fossorial peraeopods of same character.

Length 5·2 mm.

Loc. New South Wales: off Jibbon, 45–50 metres, coarse sand (Cronulla Trawl Station 10, Aug. 1943), and off Wata Mooli, 35 metres, on sand (Cronulla Trawl Station 2, July 1943). Type female in South Australian Museum, Reg. No. C. 2426.

Females only were taken. The shape of the carapace is reminiscent of *Campylaspis*. This and the structure of the posterior peraeopods, readily distinguish it from *pinguis*.

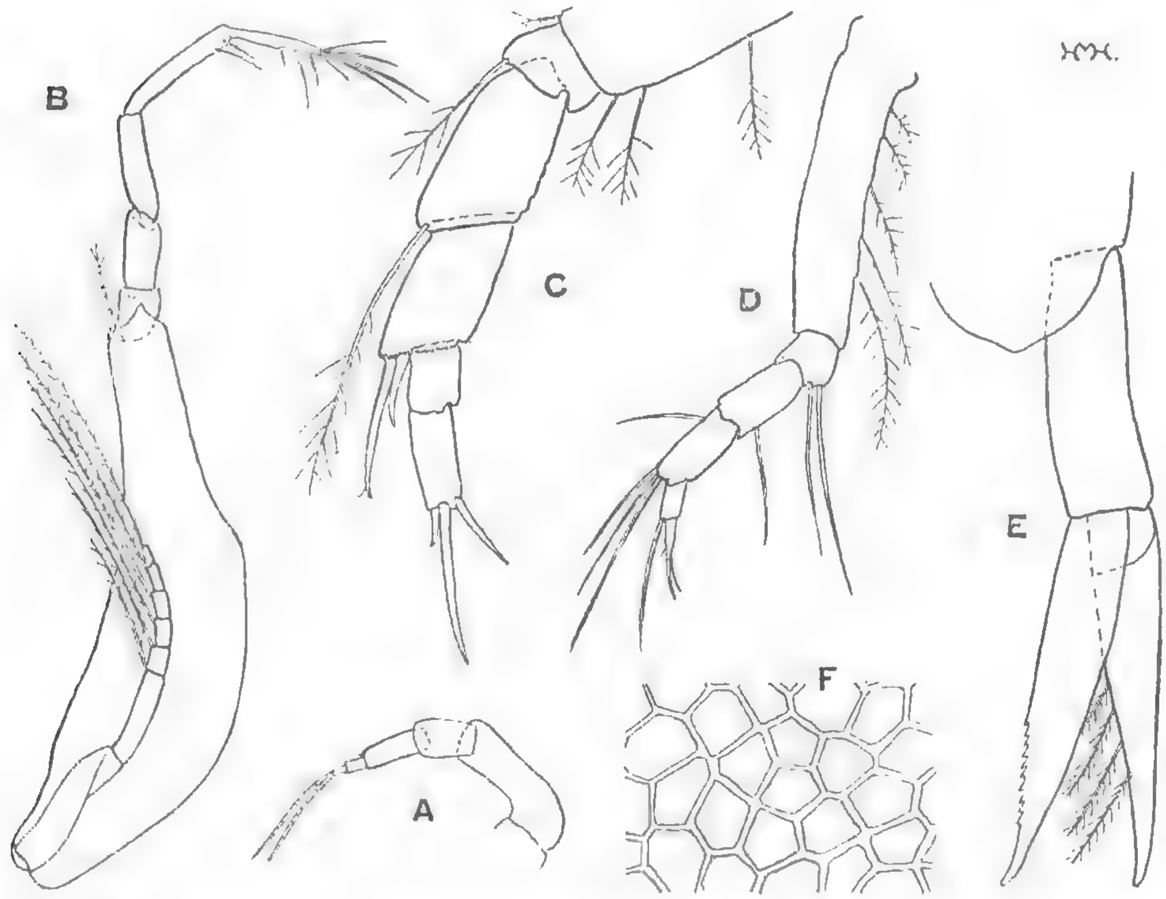

Fig. 26. *Cyclaspis globosa*, paratype female; A, first antenna; B, C and D, first, second and third peraeopods; E, uropod; F, reticulation of integument (A, D and E, × 64; B, × 40; C, × 115; F, × 325).

CYCLASPIS CLARKI sp. nov.

Subadult female. Integument highly indurated, with rather large reticulations, the edges of which are thickened to produce a coarse pitting, which gives the carapace in particular a roughened appearance.

Carapace subglobose, with dorsum strongly arched from side to side, and from front to back; one-third of total length excluding telsonic somite, widest in posterior half, where the breadth is five-sixths the length and much more than the vertical depth; dorsum with a fine but unbroken distinct median carina for whole length. Antennal notch deep and moderately wide, antennal tooth large and subacute. Psudorostral lobes just meeting in front of ocular lobe, narrowly truncate in front. Ocular lobe moderately large, subtriangular, a little longer than wide, not constricted at base, and with colourless lenses (five apparent) at sides and apex.

Four pedigerous somites are exposed; together they are only half as long as the carapace; the second somite is scarcely or not longer than any of the others, and its dorsal margin curves steeply down from that of the carapace; each somite, including the anterior spaces between the rounded portions, has a fine median carina.

Pleon longer than thorax; each somite subglobose and with a median carina, otherwise without sculpture; first to fourth and telsonic somites subequal in length; articular pegs only slightly developed.

Basis of third maxillipeds more than twice as long as rest of limb, its outer lobe not reaching distal end of lobe of merus.

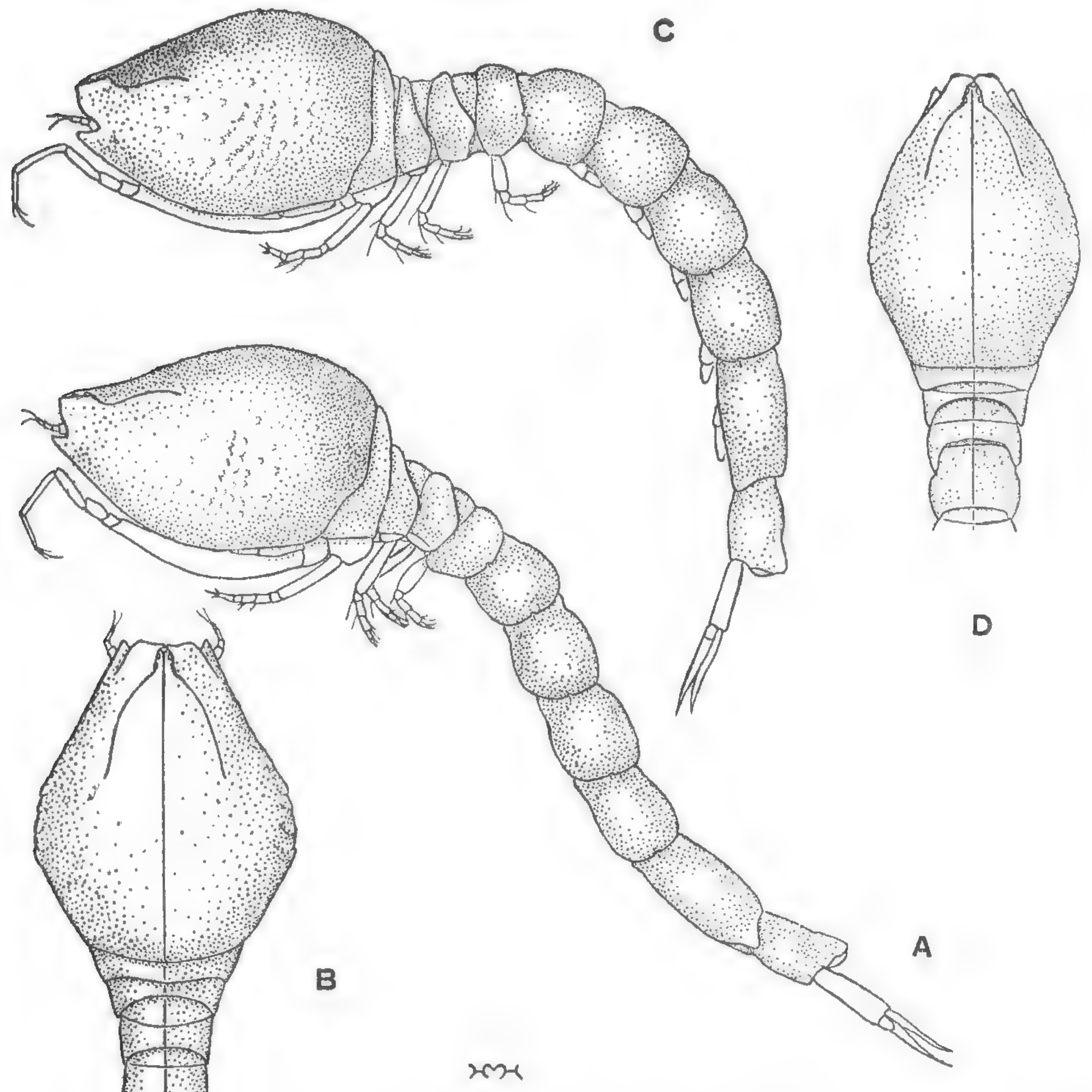

Fig. 27. *Cyclaspis clarki*, type female; A, lateral view; B, cephalothorax from above. Allotype male; C, lateral view; D, cephalothorax from above (× 15).

First peraeopods with carpus not reaching level of antennal tooth; basis one-sixth as long again as remainder of limb, with an external plumose seta, and a shorter inner seta, at apex, the inner angle of which is barely produced; carpus distinctly shorter than propodus, which is fully half as long again as dactylus.

Second peraeopods stout, not much longer than third to fifth; basis longer than rest of limb; merus as long as carpus and propodus together and with a plumose seta; carpus with two stout unequal spines; propodus two-thirds as long as dactylus, which has the terminal spines stout, the longest longer than the joint, the other two subequal in length and less than half as long.

Third to fifth peraeopods with fossorial setae not reaching beyond dactylus; two carpal setae, one stout and one feeble (fig. 28, D); basis of third longer than rest of limb.

Peduncle of uropoda stout, not quite as long as telsonic somite and equal in length to endopod, which is serrate on inner margin; exopod slightly longer, with a few plumose setae on distal half of inner margin, both rami wide, with simple apices.

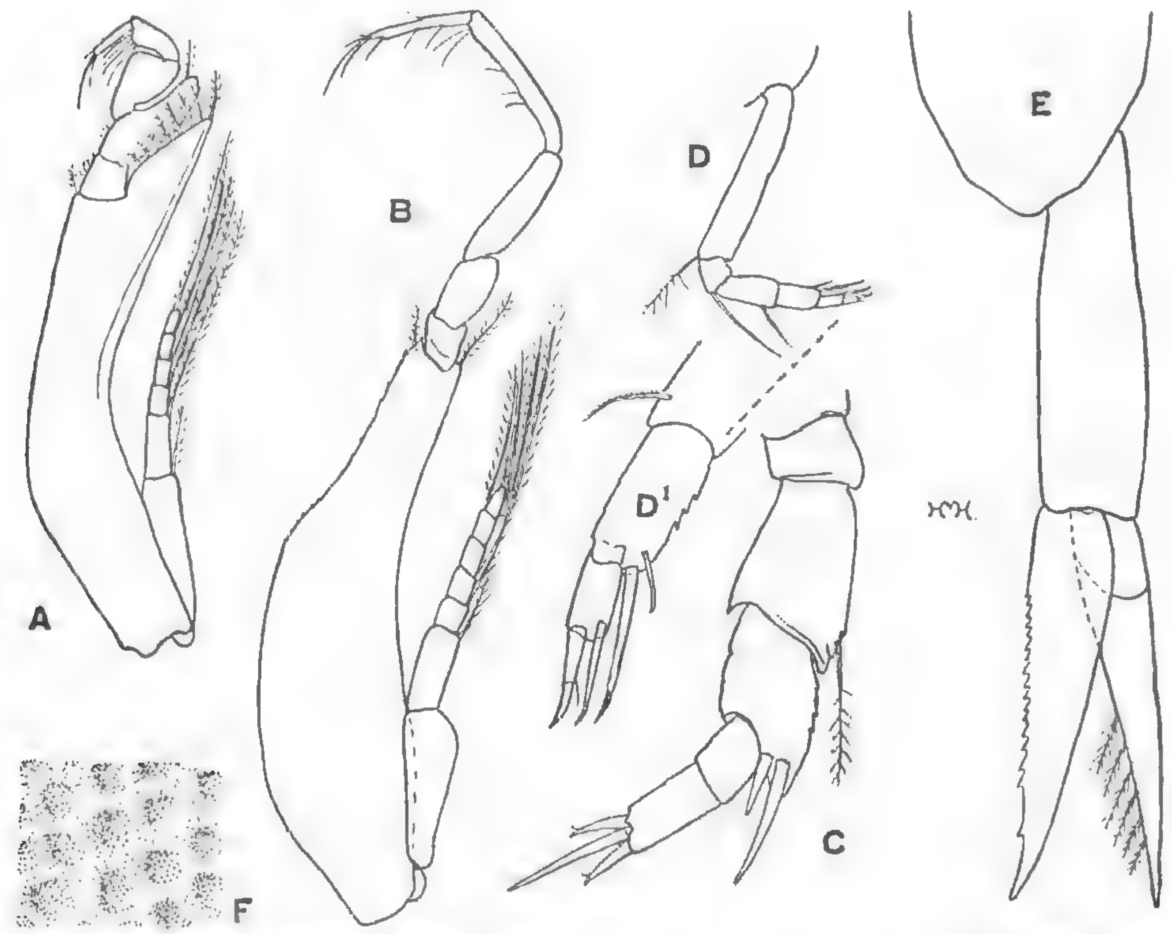

Fig. 28. *Cyclaspis clarki*, paratype female; A, third maxilliped; B, C and D, first, second and third peraeopods; E, uropod; F, reticulation of integument (A, B and D, × 40; C and D1, × 115; E, × 64).

Colour very pale brown, almost cream.

Length 7·6 mm.

Subadult male. Carapace narrower than in female, its width equal to depth and to three-fourths of length. First peraeopod slightly longer.

Length 7·6 mm.

Loc. Tasmania: off Babel Is., lat 39° 55′ S., long. 148° 31′ E. ("Warreen" Station 29, 1939). New South Wales: off Jibbon, 46-55 fath., sand to mud ("Thetis" Station 48, Mar. 1898), and off Cape Three Points, 41-50 fath., sticky mud and shell ("Thetis" Station 13, Feb. 1898). Type female in South Australian Museum, Reg. No. C. 2347; allotype male in Australian Museum, Reg. No. C. 2235.

This species is named after Mr. G. Clark, technical officer on the "Warreen," who was responsible for care of nets, etc. It has the general appearance of *pinguis* and *globosa* but can be separated with the naked eye by the different shape of the

carapace, and its slightly rugose outline when viewed from above; this rugosity is due to the fact that the thickened margins of the reticulations are particularly prominent on the middle of the sides. Further, in both *pinguis* and *globosa* the integument is much less calcified, with the reticulation sharply defined, the pleon is more slender, the spines of the second peraeopods are longer, etc.

C. pusilla Sars apparently also has very feeble, articular abdominal pegs; Sars (1887, p. 19) does not indicate them at all in his figures 21 and 22.

CYCLASPIS PINGUIS sp. nov.

Ovigerous female. Integument indurated, with clear-cut coarse reticulations, larger than in *globosa* (cf. F, fig. 26 and 30).

Carapace subglobose, strongly arched from back to front and from side to side; ovoid in shape as seen from above, tapering slightly to the front and widest at middle of length, where it is distinctly broader than deep; depth more than

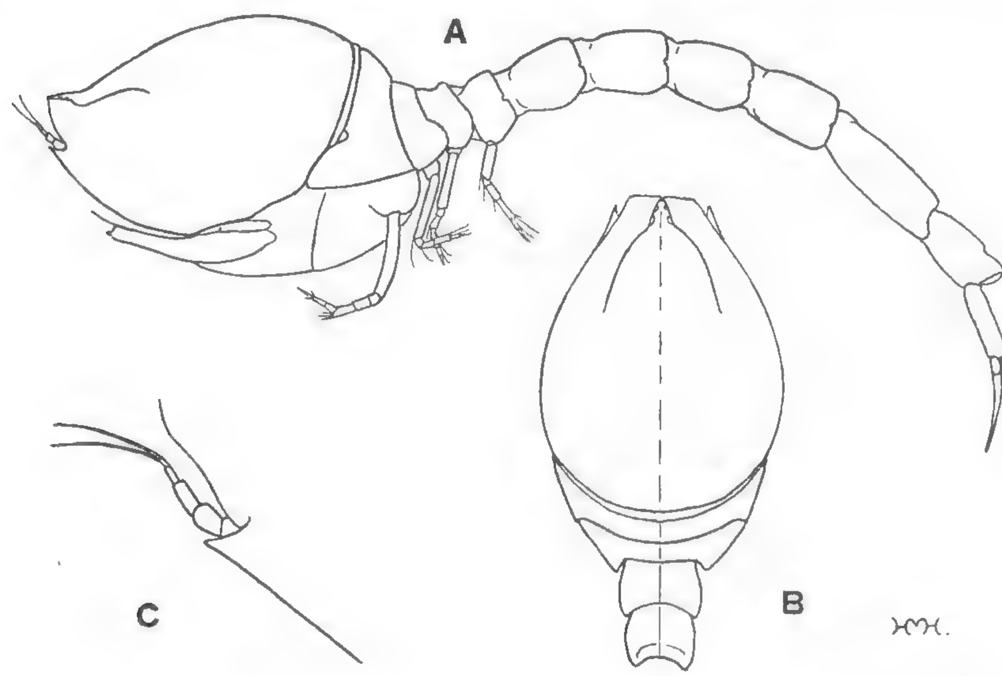

Fig. 29. *Cyclaspis pinguis*, type female; A, lateral view; B, cephalothorax from above. C, antennal notch and first antenna of male (A and B, × 15; C, × 40).

two-thirds of length. Antennal notch deep and rather narrow; antennal tooth acute. Ocular lobe as in *clarki* and *globosa*. Pseudorostral lobes just meeting in front and narrowly truncate anteriorly.

A dorsal carina runs for whole length of carapace, pedigerous somites and pleon; it is very distinct but very fine; structurally it is formed by the arrangement end to end, in a median longitudinal line, of the raised margins of the reticulations (fig. 30, F).

Five pedigerous somites are exposed, the first being short; together they are more than two-thirds as long as carapace; second expanded laterally, where it is almost as long as third to fifth combined, and with dorsal margin, seen from the side, continuing the even curve of the carapace.

Pleon slender, and flexible, with feeble articular pegs; each somite subcylindrical; first to fourth and telsonic somites subequal in length; fifth about half as long again as any one of them.

First antenna with basal joint robust, almost as long as remaining joints of peduncle and flagellum without the jointed terminal sensory appendages, which are as long as the peduncle.

Third maxillipeds as in *clarki* and *globosa*.

Basis of first peraeopods with a long and a short apical plumose seta and with inner angle barely at all produced; terminal joints missing.

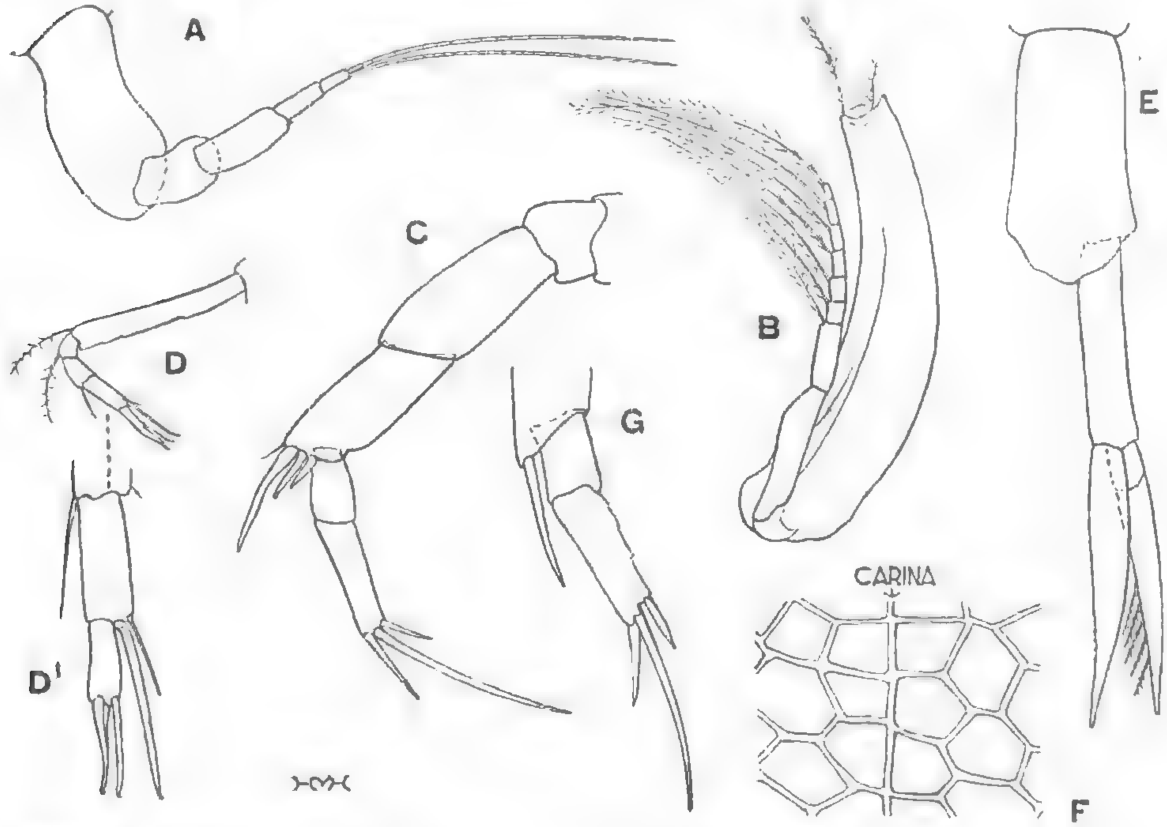

Fig. 30. *Cyclaspis pinguis*, type female; A, first antenna; B, basis of first peraeopod; C and D, second and third peraeopods; E, telsonic somite and uropod; F, reticulation of carapace and dorsal carina; G, terminal joints of second peraeopod of male (A, C, D¹ and G, × 115; B, D and E, × 40; F, × 325).

Second peraeopods stout; basis longer than rest of limb; merus equal in length to propodus and dactylus together and a little longer than carpus, which has three unequal stout spines on outer distal margin; propodus two-thirds as long as dactylus, the longest terminal spine of which is distinctly longer than propodus and dactylus together; the two remaining dactylar spines are unequal, the longer less than half length of the main spine.

Fossorial legs much as in *clarki*, but more slender (cf. D, fig. 28 and 30).

Peduncle of uropoda not very stout, shorter than telsonic somite and a little shorter than the blade-like, subequal rami, which have simple subacute apices; distal half of inner margin of exopod with a few plumose setae, that of endopod serrate.

Colour white.

Length 7 mm.

Male. (Considerably damaged). The first of the pedigerous somites is completely hidden and the second is shorter than in the ovigerous female. The antennal notch and first antenna are as in the female. The last pedigerous and

the first four pleon somites have feeble dorsal tubercles on the mid-line—these are wholly absent in the female.

Only one spine is present on the carpus of the second peraeopods, but the terminal dactylar spines are identical (fig. 30, C and G).

Loc. New South Wales: from stomach of Morwong or Jackass Fish—*Dactylopagrus macropterus* (A. C. Simpson, July 1939). Type in South Australian Museum, Reg. No. C. 2360.

The above-mentioned fish is trawled in Australian waters to a depth of at least 100 fathoms. The specimen examined had been feeding upon *Bodotria* sp., *Hemilamprops* sp., Diastylids, *C. pinguis*, etc.; most of the stomach contents were in fair condition, and include several new species of Cumacea.

The third to fifth peraeopods are as in *clarki*, but as mentioned, are less robust. Apart from the distinctive shape of the carapace the two species show many dissimilarities. In *pinguis* the pleon is markedly more slender, the three terminal spines of the second peraeopods are all of different lengths, and the surface reticulation is larger and clearly defined.

Seen from above, the thorax is of distinctive character in each of the species here assigned to the *pusilla* group.

levis group (d).

Carapace compressed, particularly in male and subadult female, the sides rising steeply to the sharp median carina of the back; pseudorostral lobes barely meeting in front of the ocular lobe, which is large, with prominent lenses.

Apex of endopod of uropod simple, that of exopod with mucrones.

Two Australian species.

CYCLASPIS PURA Hale.

Cyclaspis pura Hale, 1936, p. 405, fig. 1–2, and 1937, p. 61.

A large number of examples from Spencer and St. Vincent Gulfs, and Kangaroo Island, South Australia, are now available; some specimens were taken from the stomach of a Mullet (*Mugil cephalus*) by Prof. T. Harvey Johnston. The following additional notes are necessary to the original description.

The sides of the carapace rise steeply to the sharp median dorsal carina. The carina is distinct on the second pedigerous somite and although faint is present on all the remaining somites; there are also indications of dorso-lateral carinae on those of the pleon.

Viewed from above the carapace differs in shape in the sexes. In non-ovigerous females it is widest at about the middle of its length and the sides are evenly rounded (fig. 31, H). In the male it is very slightly widest towards the front and the sides are less curved. Ovigerous females (fig. 31, G) have the carapace widest in the posterior half and tapering towards the front. The ocular lobe (fig. 31, I) is wide in both sexes (almost as wide as long) roundly subtriangular in shape constricted at base, generously pigmented and with nine large lenses, the three in the middle dark, the lateral ones pale. There is a faint ridge, discernible only with difficulty, running back for a short distance from the antennal notch.

Five pedigerous somites are exposed always in the ovigerous female, but the first is concealed in males and subadult females.

The apex of the basis of the first peraeopod has the usual apical external plumose seta (which reaches to the middle of the length of the carpus) and a shorter internal seta; the carpus is barely longer than the propodus, which is little longer than the dactylus.

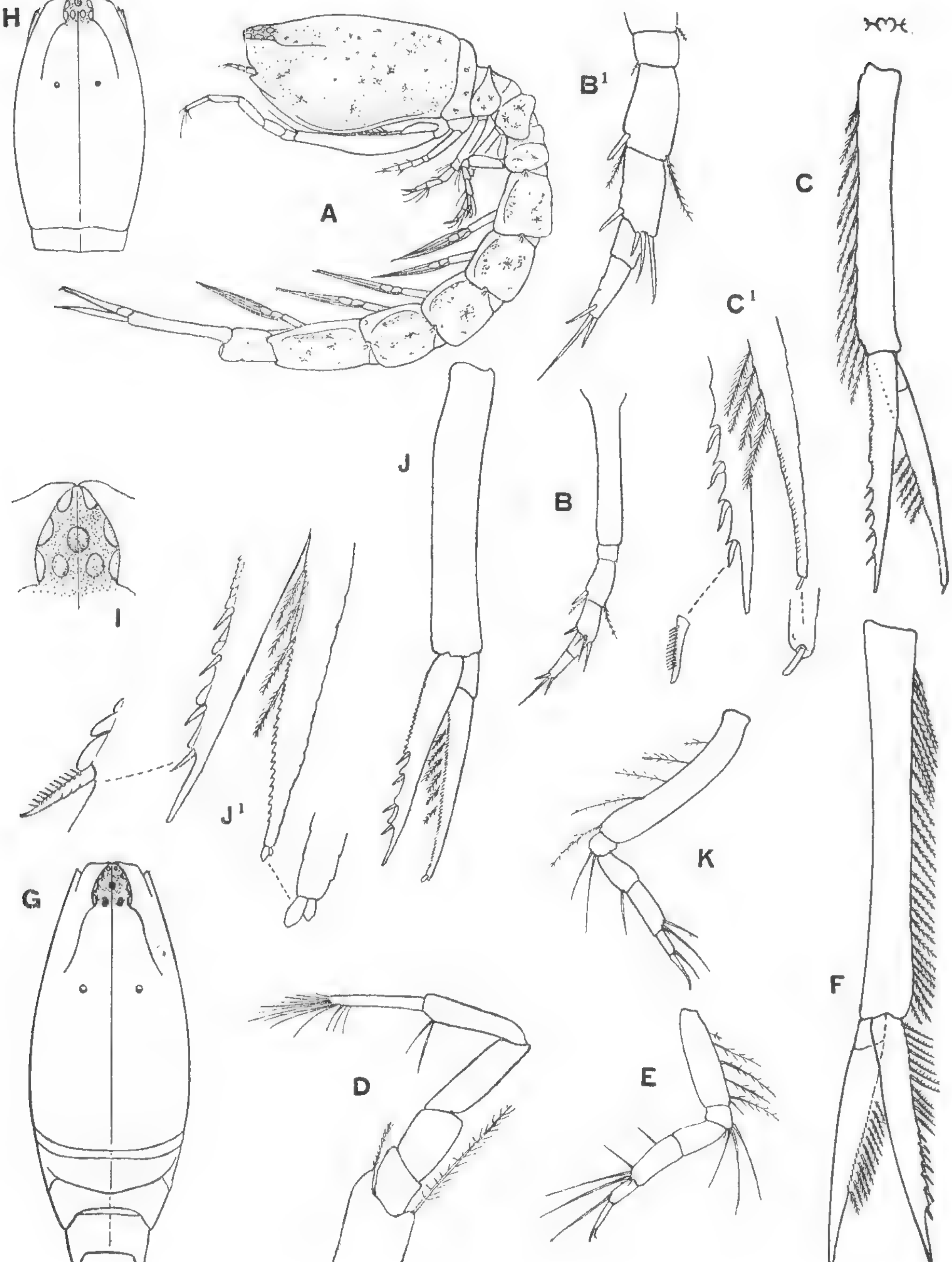

Fig. 31. *Cyclaspis pura.* Adult 4 mm. male; A, lateral view; B, second peraeopod; C, uropod and C1, terminal half of its rami. Adult 5·5 mm. male; D, terminal joints of first peraeopod; E, fifth peraeopod; F, uropod. G, Cephalothorax of ovigerous female from above. Subadult female; H, carapace from above; I, ocular lobe; J, uropod and J1, terminal half of its rami; K, third peraeopod (A, G and H, × 25; B to F, and J to K, × 64; I, × 180; B1, C1 and J1, × 115).

In the uropods the exopod is a little longer than the endopod and bears always one or two terminal mucrones.

The fossorial legs have two to three setae on the carpus, the longest reaching, with propodal seta, to apex of dactylus, or beyond it.

Adult males and ovigerous females vary in size from about 4 mm. to 6·1 mm., and one is inclined at first to recognize two species.

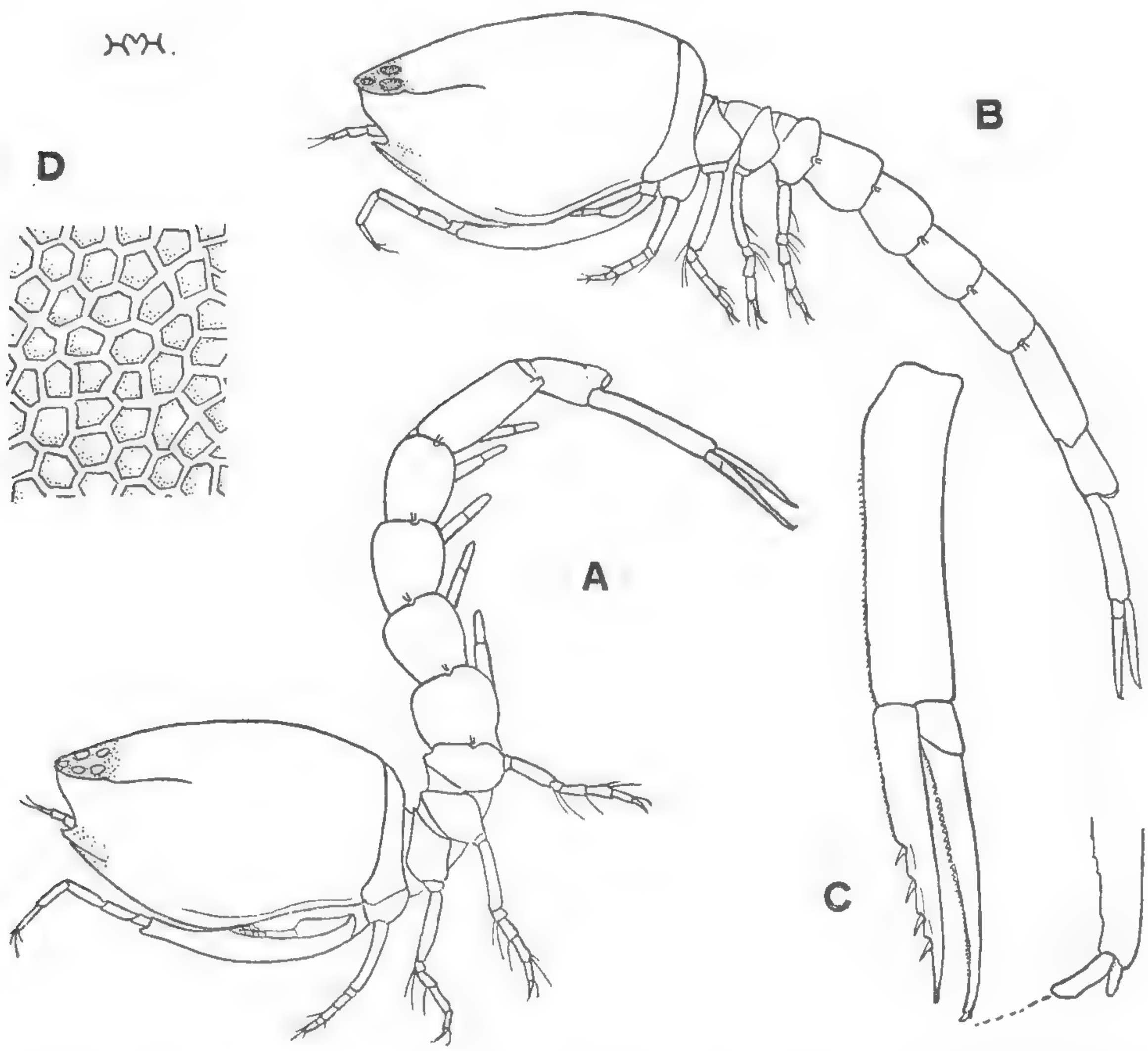

Fig. 32. *Cyclaspis pura*. A, lateral view of juvenile male. Juvenile female; B, lateral view; C, uropod; D, reticulation of carapace (A and B, × 29; C, × 84; D, × 180; mucrones of exopod of uropod, × 400).

Ovigerous females vary little excepting in size; in the smaller examples the peduncle of the uropod is relatively short, barely one-third longer than the rami.

In all females the peduncle of the uropods lacks plumose setae while the serrate inner margin of the endopod bears two to four comb-edged spines, but no proximal slender spines (fig. 31, J). The inner edge of the exopod is furnished with a few plumose setae.

Adult male (4·1 mm. to 4·7 mm.). Carapace with dorsal edge slightly and evenly arched, about two-sevenths of total length and almost twice as long as deep; in section it is almost lenticular, its width less than depth; the sides rise steeply to a sharp median longitudinal carina, which extends for whole length. Antennal notch moderately wide and deep; from it a short

shallow groove runs back and down; the short faint ridge leading back from the apex of the antennal tooth accentuates its acute appearance. Pseudorostral lobes reaching quite to apex of ocular lobe but not meeting in advance of it.

The peduncle of the uropod is relatively short, as in the female, but its peduncle bears plumose setae; the inner margin of the endopod is armed with four or five spines and in some specimens these are preceded by about half a dozen or less slender serrate spines (or setae), in others these proximal spines are entirely absent as in the female (fig. 31, C).

Basis of second peraeopods as long as rest of limb; merus longer than carpus and as long as propodus and dactylus together; with a spine at inner distal angle, and two apical setae; carpus with four distal spines; propodus about equal in length to ischium, and more than half length of dactylus, which is not as long as its longest terminal spine.

Adult male (larger form, to 6·1 mm.). The peduncle of the uropod is half as long again as the rami and bears a long row of plumose setae, the distal ones of different type; the exopod has more setae than in the smaller males, while the endopod is armed with a dozen (or a little less) slender spines on proximal half, followed by four to eight stouter spines with inset bases; the greater number of distal spines occurs in the largest of the males.

The dactylus of the first peraeopods has a terminal brush of about a dozen setae.

Subadult female. In a nearly adult female, with undeveloped marsupium, the carapace is slightly more arched dorsally than in the male, the median carina appearing rather more pronounced when viewed from above; also it is wider and deeper, and as wide as deep. Antennal notch wider. Antennal ridge and ocular lobe as in male. The first pedigerous somite is not at all exposed. The first peraeopods are relatively a little shorter, and there is no spine on the merus of the second peraeopods.

Peduncle of uropoda without long setae, much less than twice as long as telsonic somite but nearly one-third as long again as rami; exopod with six marginal plumose setae and with two terminal mucrones; inner margin with four serrate spines.

Length 4·2 mm.

Juvenile male (fig. 32, A). Carapace deeper and with dorsal margin more arched than in adult and first peraeopods a little shorter. Ocular lobe and uropods much the same.

Length 3·5 mm.

Juvenile female (fig. 32, B-D). Carapace relatively deeper than in older female and more arched dorsally. The ocular lobe is of the same shape; nine distinct lenses cannot be made out always, but appear as three large, oval, darkened areas. The peduncle of the uropoda is shorter and stouter but is a little longer than the rami; endopod with two to four marginal spines; exopod without plumose setae, but with finely serrate inner edge and two terminal mucrones.

Length 3·6 mm.

The differences in the curve of the dorsal edge of the carapace in male and female, and in the juveniles, are subtle but definite. In the last-named it is practically evenly arched, without the slight sinuation most apparent in the adult male.

CYCLASPIS NITIDA sp. nov.

Adult male. Integument thin, lightly calcified; surface shining, with tiny reticulate patterning and moderately distinct scattered pits.

Carapace with dorsal edge evenly arched (except for the usual prominence of the adult male ocular lobe); two-sevenths of the total length of animal, dis-

tinctly less than twice as long as deep, compressed, its width less than depth and barely more than half its length; there is a thin median longitudinal carina for whole length, flanked at anterior half by a low depression on each pseudorostral lobe, their hinder termination not marked by an emargination of the dorsal profile. Antennal notch rather widely open and with a short, shallow groove leading back from it; antennal tooth subacute, and no antennal ridge. Pseudorostral lobes truncate and a little sinuate in front, just meeting in advance of eye-lobe. Ocular lobe large and prominent, blackish, as wide as long, rounded, constricted at base, and with eleven large lenses.

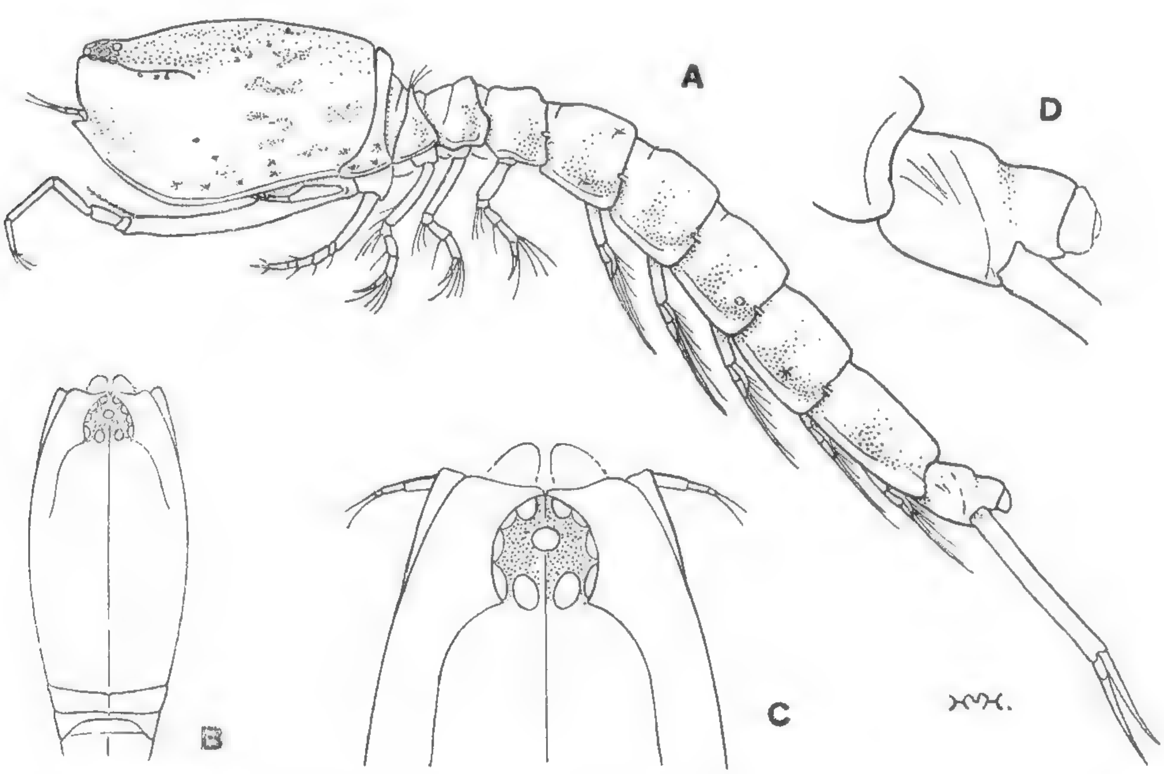

Fig. 33. *Cyclaspis nitida*, type male; A, lateral view; B, carapace and anterior pedigerous somites from above. Paratype male; C. anterior portion of carapace; D, telsonic somite from the side (A and B, × 27; C and D, × 67).

The four exposed pedigerous somites together are more than half as long as the carapace, each with a low median carina; dorsal edge of second rounded, continuing slightly obliquely the curve of the upper edge of carapace; third and fourth as long as expanded pleural portions of second; last three somites with the sides rather conspicuously tumid on posterior half.

Pleon somites stout, each with a low median carina; obsolete dorso-lateral carinae on first to fifth somites, which have the sides tumid fore and aft; telsonic somites subequal in length to first to fourth and with the dorsal notch deep.

Basis of third maxillipeds with rather narrow apical lobe, and ischium relatively long.

First peraeopod with carpus reaching just beyond level of antennal angle; basis fully one and one-half times as long as rest of limb, with a long external, plumose seta (reaching well beyond distal end of merus) and a tiny tooth-like projection, at apex; the propodus is subequal in length to carpus (barely shorter than it); dactylus rather short, two-thirds as long as propodus, and equal to longest terminal seta.

Basis of second peraeopods shorter than rest of limb; ischium and merus each with an outer plumose subapical seta; merus without spine, not as long as carpus and propodus together, and much shorter than propodus and dactylus together; carpus with inner angle produced as tiny tooth and with three slender distal spines, the outermost much the longest; dactylus relatively long, but not twice as long as propodus, inner edge serrate; longest terminal spine not quite as long as the dactylus.

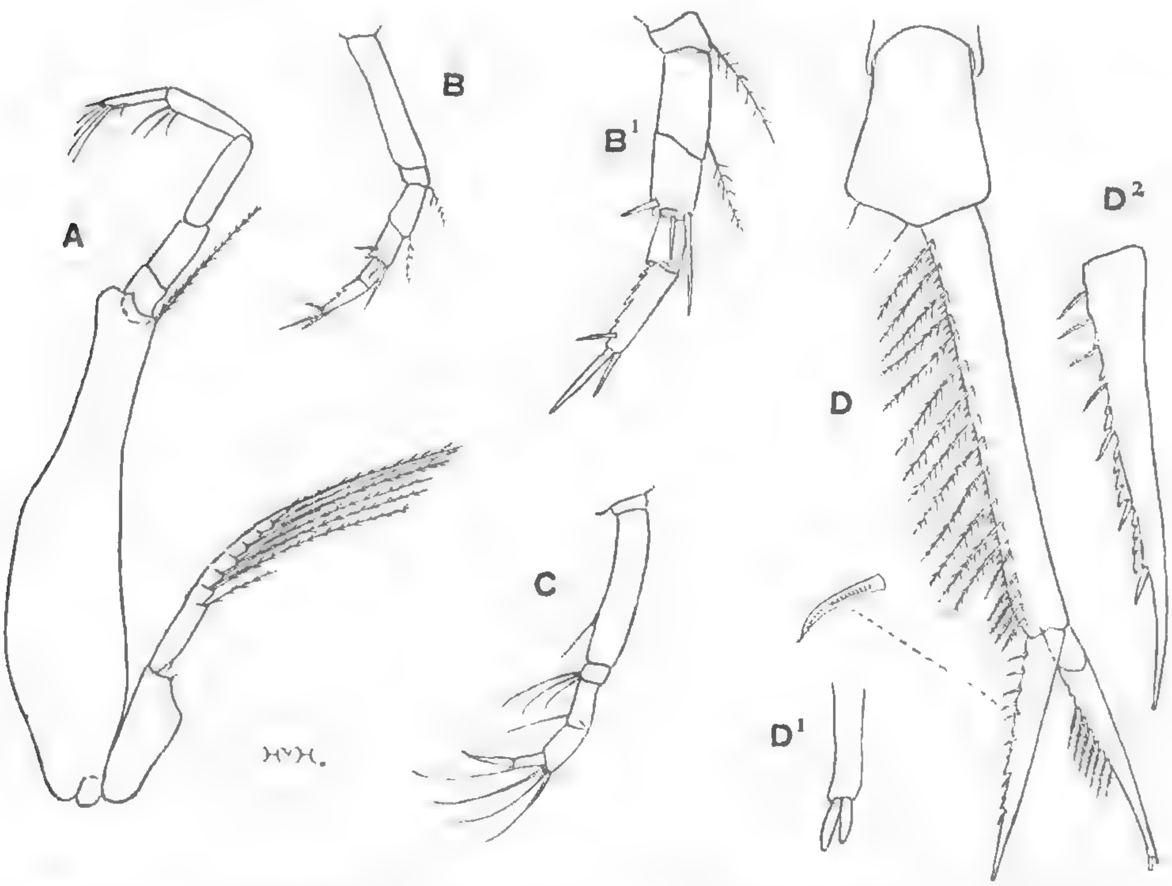

Fig. 34. *Cyclaspis nitida*, paratype male; A to C, first, second and third peraeopods; D, uropod; D1, apex of exopod of uropod; D2, endopod of uropod (A to D, × 67; B1 and D2, × 134; D1, × 270).

Fossorial legs with setae relatively well-developed (ischium three, merus one, carpus three and propodus one); the propodal seta is about twice as long as dactylus; merus and carpus subequal in length; basis of third peraeopod as long as rest of limb.

Peduncle of uropod twice as long as telsonic somite, and one and two-third times length of subequal rami; inner edges with a series of long plumose setae for whole length, the distal five shorter, more slender and serrate rather than plumose; below setae is a row of spinules; exopod with inner margin serrate and set with seven plumose setae at middle third, apically with two mucrones; endopod with inner margin serrate (as in fig. 34, D2) with five slender spines on proximal half and two spines, simpler, stouter and more downbent, on posterior half; apical third narrow, unarmed and with acute tip.

Colour: semi-transparent, with sooty mottlings and a few black spots.

Length 4 mm.

Loc. New South Wales: Cronulla, 8 feet, 8 to 8.20 p.m., and near Jibbon,

30 fath. (K. Sheard, Sept. 1942 and May 1943). Type in South Australian Museum, Reg. No. C. 2416.

Males only, taken with submarine light.

The spines on the inner margin of the endopod of the uropod vary from five to nine (proximal half) plus two to three; the exopod has seven or eight plumose setae at middle third in all examples.

Separated from the related species by the characters given in the key. Easily determinable under low magnification are the absence of slight dorsal emargination of the carapace, and antennal ridge; the short rami of the uropoda in relation to peduncle and with mucrones on exopod, together with the long setae of the posterior peraeopods.

levis group (e).

Carapace as in *pura* and *nitida*.
Apex of endopod of uropod simple, that of exopod with spines.
One Australian species, and one from New Zealand.

Cyclaspis calmani sp. nov.

Cyclaspis levis Calman (*nec* Thomson), 1907, p. 8, pl. v, fig. 6–8.

The present writer agrees with Calman in supposing some gross inaccuracies in Thomson's description of *levis* but (with apologies to Dr. Calman) assumes that the uropods and terminal joints of the first peraeopods should have been reasonably clear to the author of the species and that his figures of these features are, with reservations, useful.

The examination of a large number of specimens of various species of the *levis* group substantiates the fact that the presence or absence of terminal spines on the rami of the uropods or of mucrones on the exopod alone, provides a constant and reliable specific character. Thomson shows the apices of both rami as simple and it seems unlikely that he could have overlooked terminal spines while observing the armature of the inner margin of the endopod (see also notes under *levis* herein).

The two species in question would be separated thus:

Exopod of uropod with an apical spine. First peraeopods with propodus little longer than carpus. *calmani.*

Both rami of uropod without terminal spine. First peraeopods with propodus much longer than carpus (nearly as long as merus and carpus together). *levis.*

Cyclaspis cottoni Hale.

Cyclaspis cottoni Hale, 1937, p. 62, fig. 1–2.

Some adult males, up to 4 mm. in length, and secured by submarine light collecting in two fathoms, are available from Pt. Lincoln and Corny Point, Spencer Gulf, South Australia. The male allotype, also from Spencer Gulf, was not fully mature.

The carapace of these males is wider in front than in the ovigerous female (Hale, *ut supra*, fig. 1, b) and the breadth across the front is about equal to that posteriorly; the ocular lobe is not much longer than wide, is black in colour, and bears nine distinct lenses; the middle three are black and are larger than the lateral ones, which are pale yellow and increase successively in size from front to back; the dorsal carina of the carapace reaches to apex of ocular lobe.

The first antennae are a little longer than in the female. First peraeopods much as in female but dactylus is a shade shorter, two-thirds length of propodus, and has a strong terminal seta and two or three thinner and shorter setae, as

in some of the related forms, not a brush such as occurs in the adult male of *pura,* etc.

The second peraeopods have a plumose seta on ischium, an outer apical spine on merus, two opposite apical spines on carpus and the dactylus is twice as long as the propodus. The third to fifth legs have the fossorial setae long, two on the carpus, and reaching well beyond apex of dactylus, as in fig. 3, H.

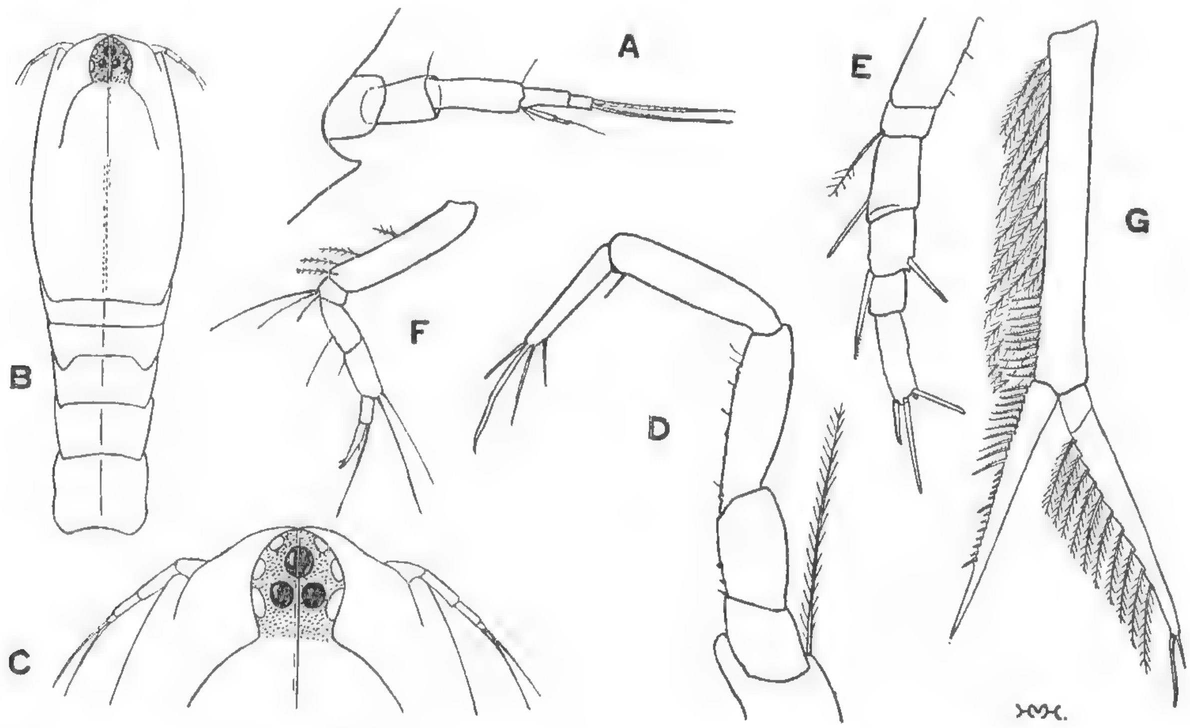

Fig. 35. *Cyclaspis cottoni,* adult male; A, antennal notch and first antenna; B, cephalothorax and first pleon somite from above; C, anterior portion of carapace; D and E, terminal joints of first and second peraeopods; F, fourth peraeopod; G, uropod (A, D and E, × 110; B, × 25; C, F and G, × 64).

In the uropoda the peduncle is more than one-third as long again as the equal rami and bears a row of plumose setae on inner margin and, above these on posterior fourth, a row of shorter setae; the inner margin of the endopod has a row of about ten setae proximally, followed by a row of thirteen short spines, five short, one longer, six short and one longer; distal portion unarmed and apex simply pointed; endopod with a series of long plumose setae; apex truncate with a long and a short terminal spine.

SECTION 2.

exsculpta group.

Each side of carapace with two antero-lateral tubercles and at least one postero-lateral prominence, the last sometimes massive; these assist in marking out the subquadrangular depressed area characteristic of the group. Excepting the spinose *aspera,* this lateral concavity is emphasized by more or less distinct enclosing ridges, including two transverse carinae which extend across the back in at least the female of all but *australis,* where only the posterior carina is developed on the back.

In the female the carapace as seen from the side, and from above, is uneven owing to bold sculpturing. Marked sexual dimorphism may occur in the fully adult (i.e. *tribulis*) and the lateral concavity of the male be hardly existent, although its outline is marked more or less by elevations and by ridges.

Mucrones are present on the apex of the exopod of the uropod of *aspera*; they are found in the juvenile of *tribulis* and *bovis* but not in the adult.

Eight Australian species, including *similis*, which is recorded from Queensland by Foxon, and excluding *exsculpta*, which was taken off the northern tip of Queensland, actually in the Austro-Malayan sub-region.

Cyclaspis tribulis Hale.

Cyclaspis tribulis Hale, 1928, p. 34, fig. 3-4.

Specimens from a number of localities and ranging in size from 2·7 mm. (juveniles with last pair of peraeopods undeveloped) to 13 mm. to 15 mm. (ovigerous females and adult males), enable one to discuss the great variation exhibited by the species.

All examples possess the median dorsal elevation, *p.o.t.* in accompanying figures, at the base of the ocular lobe, and anterior to the first transverse carina, referred to in the original description of the species; even in juveniles 2·7 mm. in length it is represented by a very slight prominence (fig. 36, G). In the sub-adult it may be tooth-like (fig. 36, F, of an example 10 mm. in length) rounded-conical, or in the form of a compound tubercle.

Ovigerous females (from Tasmania and New South Wales) show a remarkable development of the sculpture previously described for the 12 mm. subadult c.f. Hale, 1928, fig. 3, a and b with fig. 36 A–C herewith). The surface of the carapace is coarsely reticulate posteriorly, more or less strongly tuberculate or studded with blunt spines anteriorly. The dorsal elevation at the base of the eye-lobe is a transversely elongate, flat-topped tubercle and is connected by a very short longitudinal carina to the first transverse ridge. The pseudorostral suture is fused. The median dorsal ridge is wide and flattened, with irregular edges; the dorsal margin of the carapace and the dorso-lateral carina may be more or less spinose. The prominences on the transverse ridges are very large; the posterior pair are concave and spoon-like in front. The median tubercle at the hinder end of the carapace is large and conical in old specimens. The first pedigerous somite is exposed, but is short.

In the first peraeopods (imperfect in the types) the basis is a little longer than the remainder of the limb, and has serrated edges; the ischium is two-thirds as long as the merus, which is expanded distally; the carpus is twice as long as the merus, a little longer than the dactylus and three-fourths as long as the propodus: the anterior segments sometimes bear sparse black spots.

As in the types the rami of the uropods are subequal in length to the peduncle the exopod slightly longer than the endopod and with the apex dilated; the inner margin of the endopod is spinulose for half its length and that of the exopod bears strong plumose setae.

Length 13 mm. to 14 mm.

Submature males and females, 7 mm. to 10 mm. in length, may have more or less strongly developed teeth on the dorsum and on the dorso-lateral ridges; in these individuals the propodus of the first legs is longer than the carpus and the peduncle of the uropoda is as long, or almost as long, as the rami.

Juvenile examples, 2·7 mm. or so in length (and taken with a 40 mesh trawl in New South Wales), have the primary reticulation of the carapace relatively coarse and the elevations far less prominent, the propodus of the first peraeopods not or scarcely longer than the carpus and the peduncle of the uropods relatively short, only about half the length of the rami; both rami of the uropoda bear terminal mucrones (fig. 36, H^2).

Adult males (from Tasmania) are so markedly dissimilar from the subadult of this sex (c.f. Hale, 1928, fig. 3, b, and fig. 37, A–B herewith) that one is inclined to give them specific rank. Comparison, however, shows that the struc-

ture is essentially the same, and that evidently the carapace becomes elongated and narrowed in old examples, not expanded and deepened as in large females.

Integument strongly calcified and reticulated. Carapace less than one-third total length of animal, twice as long as deep, and wider than deep; as seen from

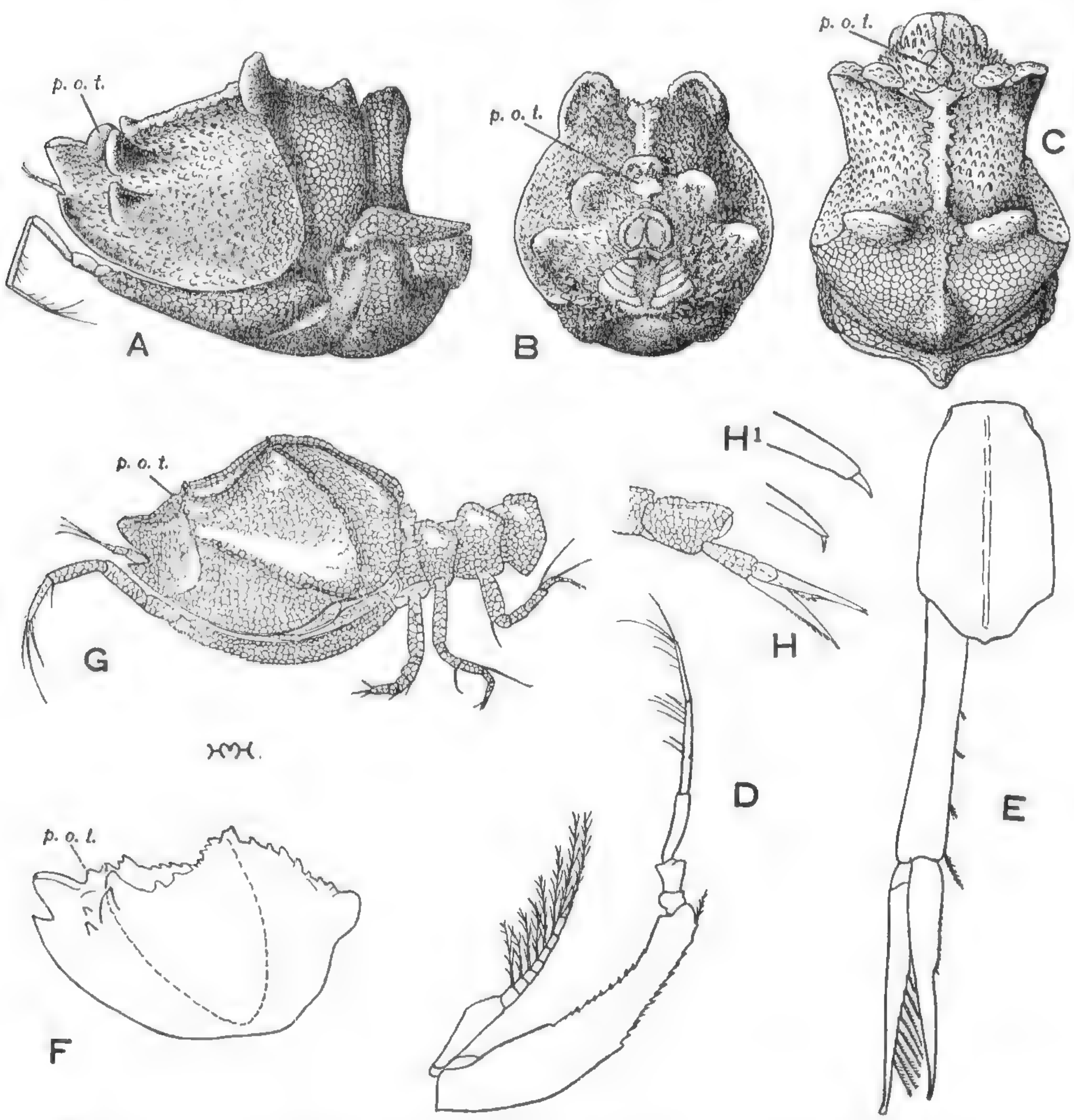

Fig. 36. *Cyclaspis tribulis*, ovigerous female; A, B and C, carapace from side, front and above; D, first peraeopod; E, telsonic somite and uropod. F, Carapace of a "spiny" non-ovigerous female. Lateral views of G, cephalothorax and H, telsonic somite and uropod of juvenile; H1, apices of rami of uropod (A to C, × 8½; D and F, × 12; E, × 20; G and H, × 34; H1, × 145).

the side the dorsal margin is only slightly elevated posteriorly, thence a little convex to base of ocular lobe, where there is a marked tumidity (*p.o.t.*); each antero-lateral area immediately behind pseudorostral lobes expanded laterally (so that in dorsal view the carapace is widest here) and with two confluent tumidities armed with conical tubercles; pseudorostral lobes with short elevated ridges; sides of carapace with coarse reticulations and a few short ridges.

Posterior to the middle of the length there is a pair of blunt tubercles (corresponding to the large postero-lateral prominences of the adult female); from each of these a faintly defined posterior transverse ridge runs obliquely back to meet, near inferior margin of carapace, a still fainter "ridge," which curves back from the lower of the antero-lateral prominences; these carinae, with the obsolete

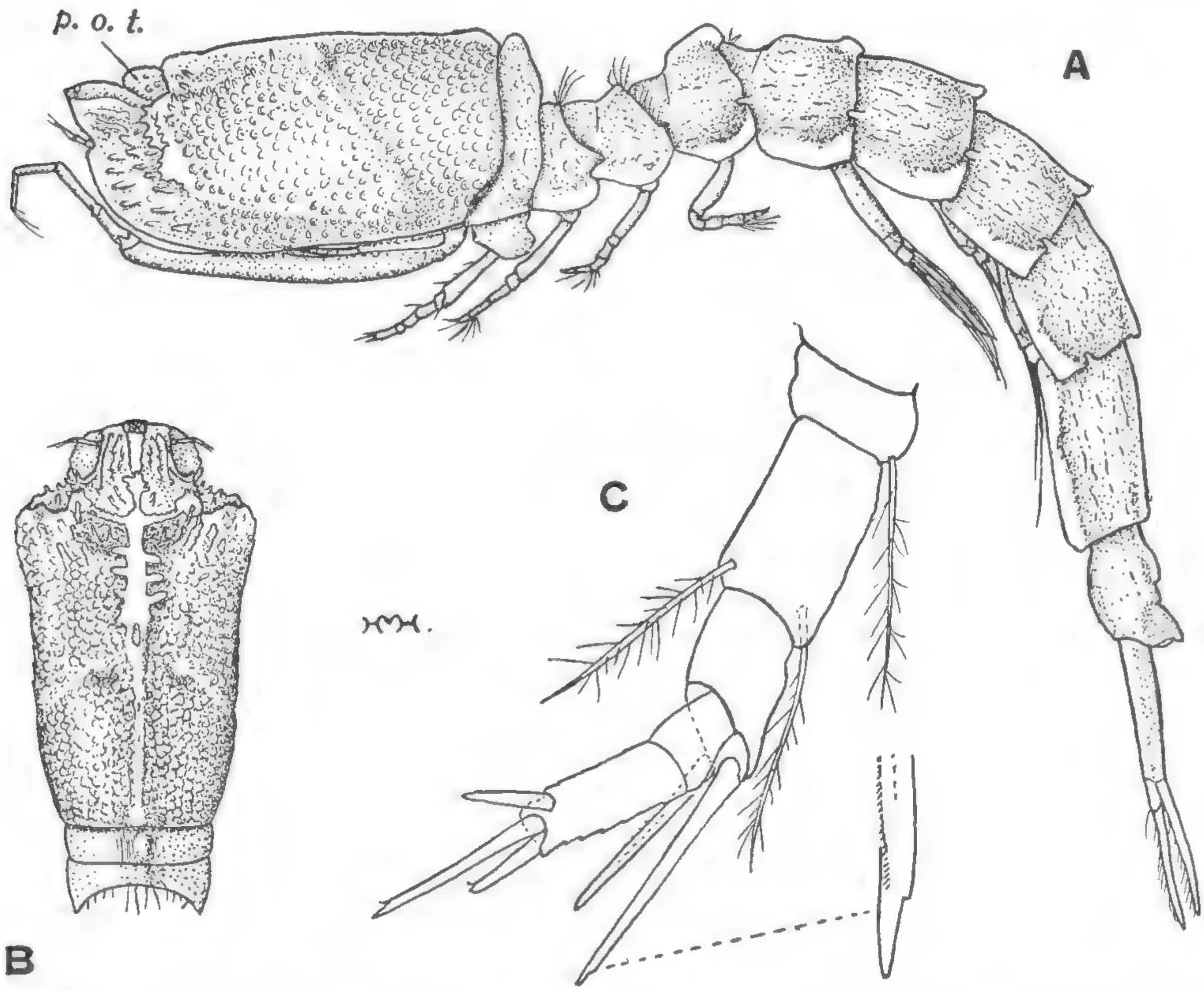

Fig. 37. *Cyclaspis tribulis*, adult male; A, lateral view; B, carapace from above; C, terminal joints of second peraeopod (A and B, × 11; C, × 84).

dorso-lateral ridge, enclose an area which is scarcely at all concave. Dorsum with a median, smooth longitudinal carina, irregularly expanded, particularly at base of ocular lobe and posterior to the pseudorostral lobes, where a few lateral projections extend from it, as in the adult female; immediately behind pseudorostral lobes an irregular flattened carina extends sideways to each of the upper antero-lateral tumidities, forming a cross with median carina. Pseudorostral lobes not quite reaching to level of apex of ocular lobe, which is narrow, widest anteriorly and bears distinct lenses. Antennal notch wide and antennal tooth obtusely angular.

First pedigerous somite concealed; second elevated dorsally, and third to fifth with dorsal carinae.

Pleon very much more robust than in adult female; each somite with median carina, produced a little backwards on first four somites (as on last pedigerous somite); first five with distinct articular pegs; fifth somite about one-fourth as long again as the others, which are subequal in length.

Third maxilliped with basis three times as long as rest of limb; outer apical lobe reaching to level of insertion of carpus; merus twice as long as ischium and half as long again as carpus, which is subequal to propodus and dactylus.

First peraeopods with distal end of carpus reaching well beyond antennal notch; basis slightly produced apically, one-third as long again as rest of limb; carpus a little shorter than propodus, one-fourth as long again as dactylus and twice as long as merus, which is half as long again as ischium.

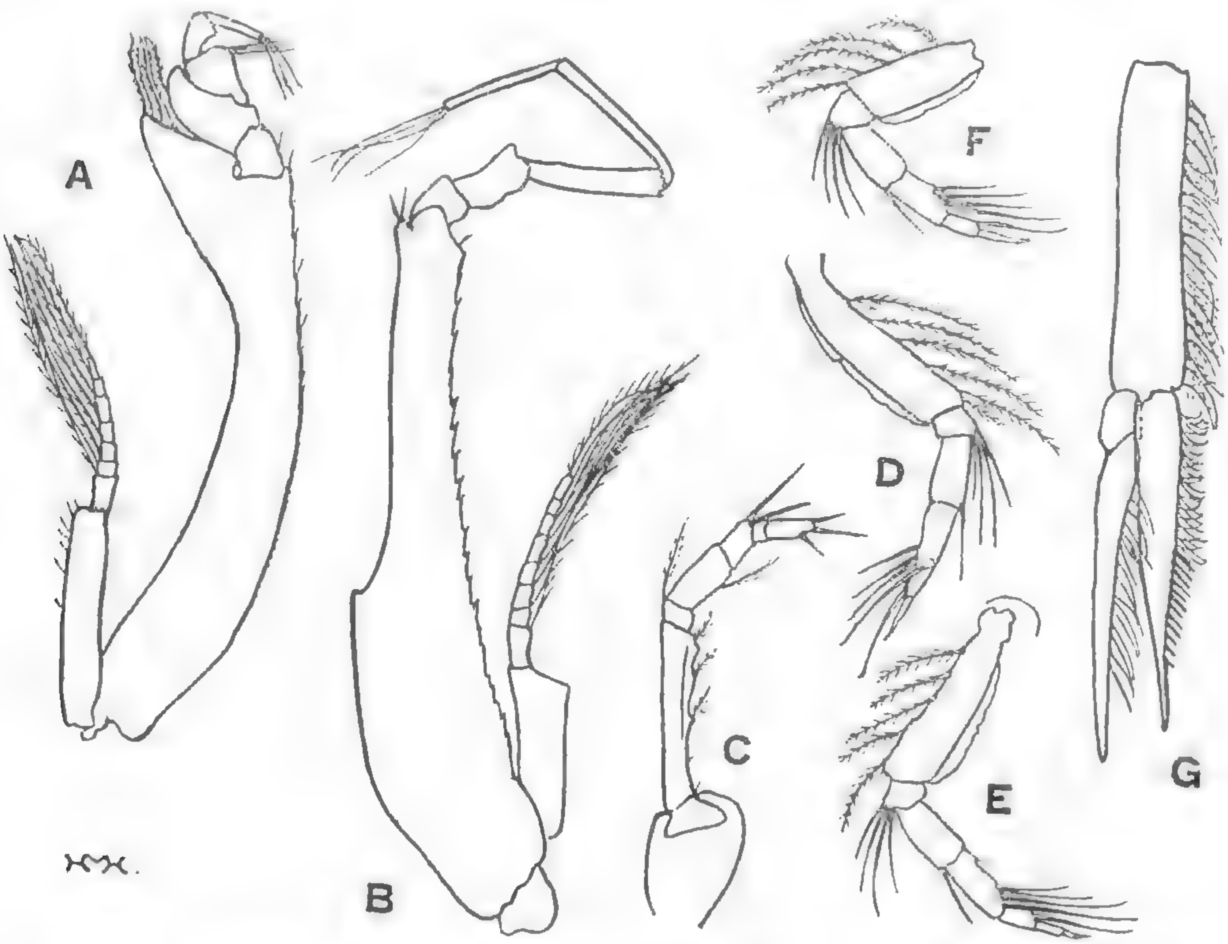

Fig. 38. *Cyclaspis tribulis*, adult male; A, third maxilliped; B to F, first to fifth peraeopods; G, uropod (× 25).

Basis of second to fifth peraeopods with carinate inner margin. Second with basis longer than rest of limb; merus with two plumose setae, longer than carpus, and about as long as propodus and dactylus together: carpus with two unequal terminal spines; dactylus with a terminal spine as long as itself and two smaller spines. Basis of fourth and fifth peraeopods deep, little more than twice as long as depth (including crest) in fifth.

Peduncle of uropoda about one-fourth as long again as telsonic somite and equal in length to exopod, which is one-tenth as long again as endopod; inner margin of exopod with setae, that of endopod with hairs on anterior half and about a dozen short spines on posterior half; inner margin of peduncle with plumose hairs.

Colour white.

Length 13·5 mm. to 15 mm.

Loc. Tasmania: off Babel Is., 0–50 metres ("Warreen" Station 29, 1939). New

South Wales: Lat. 28° 37′ S., long. 153° 42′ E. (K. Sheard, submarine light, Sept. 1938, 10.30 p.m. to 12.5 a.m.); off Wata Mooli, 70 metres, 9 a.m., and off Jibbon, 70 metres, and 45–50 metres (K. Sheard, July-Aug. 1943).

Hab. South Australia, Tasmania and New South Wales.

The above characters and those mentioned in the original description serve to separate *tribulis* from the North-Western Australian *supersculpta* Zimmer (1921, p. 7, fig. 8-11). Even in the very young of *tribulis* there is a slight trace of the elevation at the base of the eye-lobe, not shown in the figure of Zimmer's much larger specimen. It is unfortunate that a complete individual of *exsculpta* Sars (1877, p. 20, pl. i, fig. 24-26) from Torres Strait, is not available. Sars' species, described from the thorax only, was under 5 mm. long (estimated by Stebbing, 1913, p. 35) and while the sculpture is entirely different from that of *tribulis,* it is very close to *supersculpta.*

CYCLASPIS BOVIS Hale.

Cyclaspis bovis Hale, 1928, p. 32, fig. 1–2.

A young example, 6·5 mm. in length, and with the last pair of peraeopods not developed, is referred to this species; it has the carapace relatively more massive and more strongly sculptured than in the almost adult female (c.f. fig. 39, A and Hale, 1928, fig. 1).

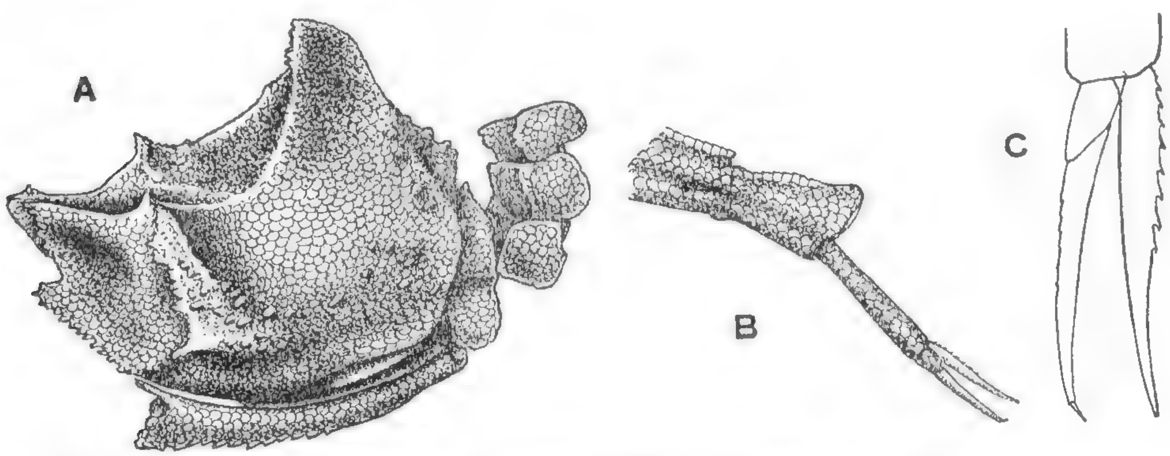

Fig. 39. *Cyclaspis bovis,* juvenile; lateral views of A, thorax and B, telsonic somite and uropod; C, rami of uropod (A and B, × 12; C, × 66).

The sides of the carapace are conspicuously excavate; the depression is bounded in front by the large and very much elevated antero-lateral tooth and dorso-laterally by a ridge extending forward from the posterior horns; the remainder of the edges of the depression bears large granules; these last are vaguely grouped at the sites of the two low elevations which are recorded for the types on the posterior part of the sides.

The anterior transverse ridge is elevated and tuberculate medianly; the sculpture of the integument is squamose-reticulate.

The uropods are relatively shorter than in the adult and the apex of the exopod (dilated in the adult) has a mucro; the endopod is barely longer than the exopod, is four-fifths as long as the peduncle (less than half as long in adult) and the inner margin has eight teeth.

Loc. New South Wales; off Cape Three Points, 41-50 fath. ("Thetis" Station 13, Feb. 1898).

The species is large; the South Australian types, though immature, are 18

and 19·5 mm. in length. It has the same general plan of sculpture as its ally, the Austro-Malayan *persculpta* Calman (1905, p. 3, pl. i, fig. 1-3), but presents a number of obvious differences.

This young specimen offers an interesting comparison with the juveniles of *tribulis* in that the sculpturing is more massive than in the subadult; the condition is reversed in *tribulis*.

CYCLASPIS MAWSONAE sp. nov.

Adult male. Integument strongly calcareous.

Carapace a little less than one-third of total length, twice as long as deep and a little wider than deep; in profile the dorsal margin is slightly convex, with a shallow indentation at about middle of length.

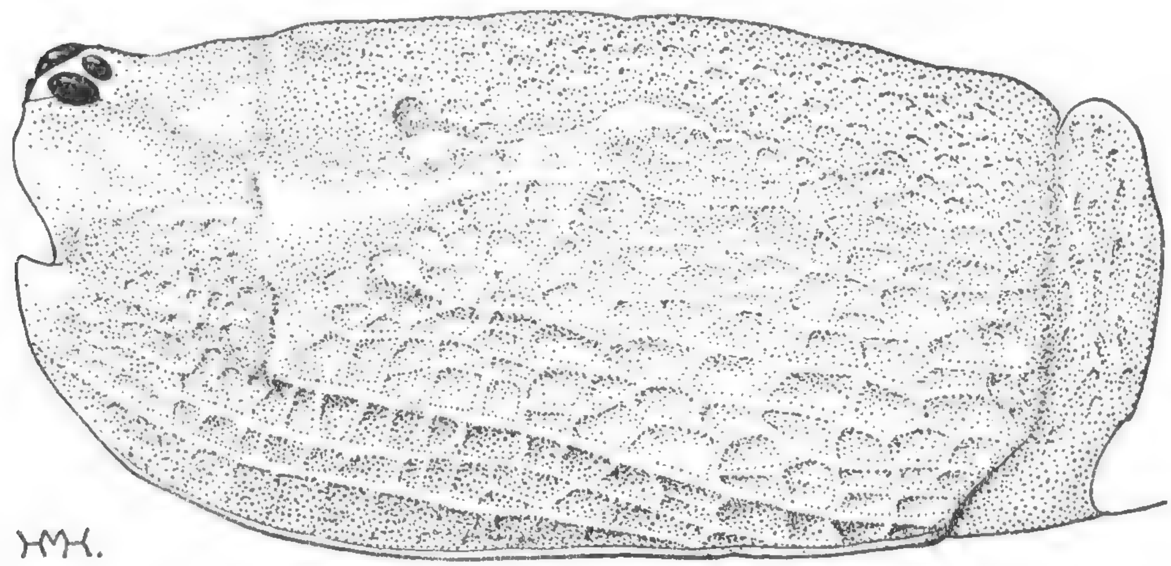

Fig. 40. Carapace of paratype male of *Cyclaspis mawsonae* (× 42).

The carapace is coarsely reticulately pitted, with a fine reticulate background pattern as described for *usitata*, but the coarse reticulations are particularly large and distinct and their edges, arranged end to end, play an important part in the formation of longitudinal ridges (see fig. 40); the limy granules of the integument are thick on the raised edges of the large reticulations, but the bottoms of the pits are less calcified (fig. 41 D, by transmitted light).

The anterior transverse carina crosses the back and continues to the sides, where it traverses the two antero-lateral tubercles; from the lower of the last-named a longitudinal ridge, emphasized by the edges of the large reticulations, runs back to the hinder margin of the carapace; beneath this a similar ridge extends from below the antennal tooth to the inferior margin, near its hinder end; above it the edges of the reticulate pits mark less defined longitudinal carinae and there is a dorso-lateral ridge; the posterior transverse ridge is absent, but is indicated by a scarcely discernible irregularity of the surface; there is a blunt dorsal longitudinal ridge. Pseudorostral lobes barely reach to level of apex of ocular lobe, which is moderately wide, with bisinuate anterior margin, and bears seven pigmented lenses, arranged as in fig. 41 C. Antennal notch rather narrow and antennal tooth subacute; pseudorostral suture fused.

Pedigerous somites together two-thirds as long as carapace; first somite concealed; second, fourth and fifth somites each with an elevated carina, that of

second and fourth almost tooth-like; second to fifth somites successively increasing in length and with infero-lateral portions more or less backwardly produced.

First antenna with basal joint longer than second and third together; flagellum shorter than second or third joints, which are subequal in length.

Third maxilliped with basis about two and three-fourths times as long as remaining joints together; outer apical angle rounded, reaching to level of middle of length of merus, which is more than twice as long as carpus; dactylus, propodus and carpus subequal in length.

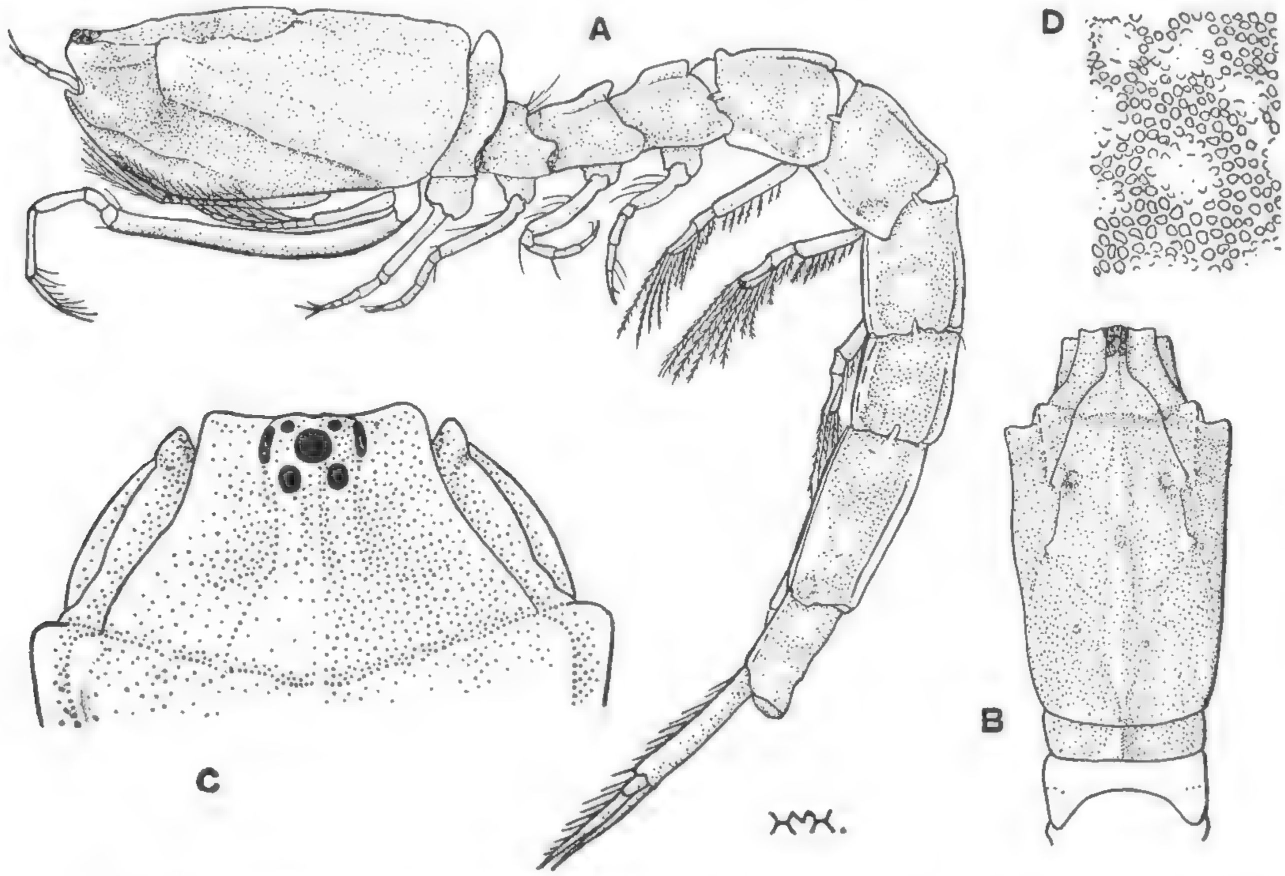

Fig. 41. *Cyclaspis mawsonae*, paratype male; A, lateral view; B, dorsal view of carapace; C, anterior portion of carapace; D, calcification of carapace (A and B, × 15; C, × 40; D, × 72).

First peraeopods with distal end of carpus reaching beyond antennal angle; basis nearly one-half as long again as remainder of limb, with apex produced and with two plumose setae; merus half as long again as ischium and more than half as long as carpus which is a little shorter than propodus and longer than dactylus.

Second peraeopod with basis a little longer than rest of limb, with merus almost as long as carpus and propodus together; dactylus almost as long as carpus and one-third as long again as propodus, with a stout terminal spine much longer than itself and two shorter robust spines; ischium and merus each with a plumose seta; carpus with two stout unequal spines, the longer serrate, and reaching to level of apex of dactylus.

Basis of third peraeopod as long as rest of limb, and with long plumose setae on inner margin; ischium with two setae; merus equal in length to carpus and with one subapical seta; carpus about one-half as long again as propodus, and bearing two subapical setae (almost slender spines) and a spine which reaches level of apex of dactylus; propodus with a similar but shorter spine, also

reaching to same level (fig. 42, D); dactylus almost as long as propodus, with a slender subapical spine and a minute spine on outer margin; fourth and fifth peraeopods similar, but basis as usual successively shorter.

Peduncle of uropoda about one-sixth as long again as telsonic somite and subequal in length to exopod, which is barely longer than endopod (35.34) and

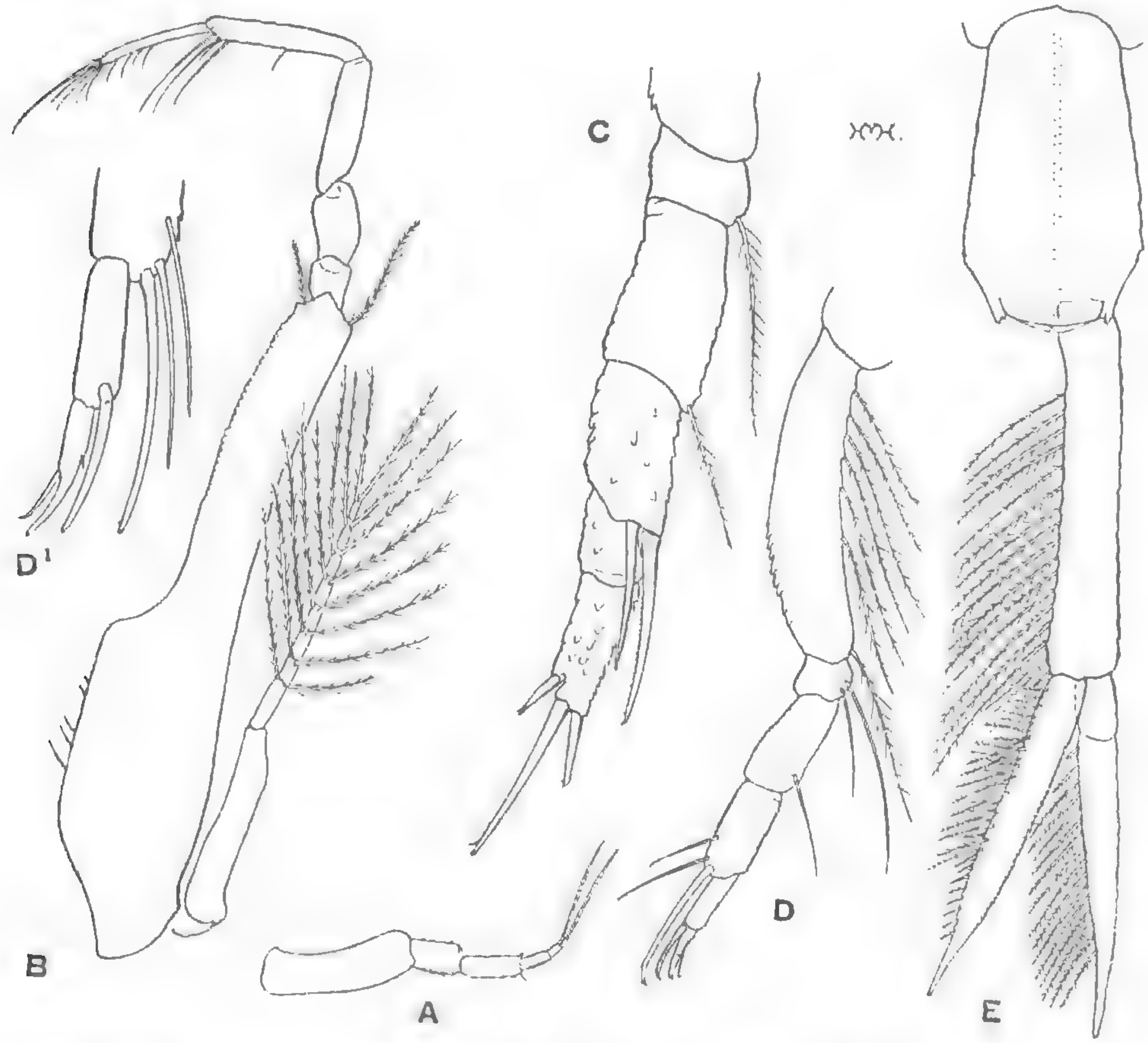

Fig. 42. *Cyclaspis mawsonae*, paratype male; A, first antenna; B, C and D, first, second and third peraeopods; E, telsonic somite and uropod (A and D, × 64; B and E, × 40; C and D[1], × 115).

has the apex subacute and simple; inner margins of exopod and peduncle with a dense fringe of long setae; endopod with acute apex but no terminal spine, the inner margin with two rows of plumose setae on proximal half and about eight spines on distal half; terminal fifth of both rami unarmed.

Colour white, with a few large and rather scattered brown spots.

Length 10 mm.

Loc. South Australia: St. Vincent Gulf, off Brighton jetty (Patricia Mawson and L. M. Angel, submarine light, Oct. 13, 1941, 9.30 to 9.45 p.m.). Type male in South Australian Museum, Reg. No. C. 2356.

Over three hundred specimens were taken from a swarm of males, and a series of thirty or so was preserved. As shown in the figures, plumose setae are well-developed on the basis of the fossorial legs and on the uropods.

This species, which is named after Miss Patricia Mawson, somewhat resembles the male of *tribulis*, but the sculpturing is very different, and the joints of the maxillipeds and peraeopods are of different proportions.

Although *mawsonae* obviously belongs to the *exsculpta* group, it has no posterior transverse carina (mere suggestion only) and no quadrangular depression on the side. *C. candida* (male only known) has a faint posterior transverse carina according to Zimmer (1929, p. 9, fig. 12-13), the inferior portion of the carapace is not marked off by an oblique longitudinal ridge running back from below antennal tooth, the lower ridge of the "quadrangle" does not continue right to the hinder edge of the carapace, and the upper margin of the second pedigerous somite is steeply oblique, not elevated as in *mawsonae*.

Acceptance of the fact that extreme sexual dimorphism occurs in *tribulis* leads to consideration of the possibility of an association between the swarming of *mawsonae* males and that, a week later at the same place, of newly moulted *usitata* females with fully developed but empty marsupium.

In the case of *tribulis*, however, there are definite features linking the sexes —the presence of a post-ocular tubercle at all stages, the distinctive character of the dorsal carina of the carapace, the fossorial limbs, etc. There are no such parallels in *mawsonae* and *usitata*, but on the contrary the sculpture of the carapace and the fossorial limbs are markedly different; the setae of these peraeopods are much longer in *usitata*, and in both sexes of *tribulis*, than they are in *mawsonae* (c.f. D in fig. 42 and 43).

CYCLASPIS USITATA Hale.

Cyclaspis usitata Hale, 1932, p. 549, fig. 1.

Further material throws a little more light on this species, which is apparently abundant in parts of St. Vincent Gulf, South Australia; as previously suggested it is possible that *usitata* is the female of *candida* Zimmer (1921, p. 9, fig. 12-13) from North-Western Australia.

Like the members of the *exsculpta* group in general, it is a highly calcified species. The type (10 mm.) is the largest example so far secured. In this the second transverse carina of the carapace is interrupted on the back.

Adult females. A large number of females, 7 mm. or so in length, was collected at Brighton, South Australia, by Miss Patricia Mawson, using a submarine light. In these the second transverse carina of the carapace is continued across the back to the median carina, although it is faint immediately alongside the last-named. The anterior transverse ridge, as it crosses the back, has a well-marked median projection, sometimes tooth-like; it is more distinct inferiorly than in the larger type female.

First antenna stout and relatively large, with basal joint shorter than second and third together; third little longer than second; flagellum very short.

The basis of the second peraeopods is a little longer than the rest of the limb and its inner edge bears a row of stout plumose setae; ischium and merus each with two subapical setae but no spines; carpus short, together with propodus as long as merus, and with one stout apical spine; longest terminal spine of dactylus as long as dactylus plus propodus. Fossorial peraeopods stout; carpus not much longer than merus and with three subterminal setae which with propodal seta reach well beyond apex of dactylus (fig. 43, D).

Peduncle of uropods distinctly shorter than rami, with plumose hairs, on inner margin; exopod a little longer than endopod, with a long row of inner plumose hairs, and with apex subacutely rounded; endopod with inner edge serrate.

Subadult females (New South Wales), show the surface patterning well. The front of the pseudorostral lobes, the antennal tooth area and part of the lower edge of the carapace are finely reticulate; beyond these portions there occurs a coarse reticulate or squamose pitting with diameter about six times that of the small reticulations, which are continued on the edges of the secondary reticulation.

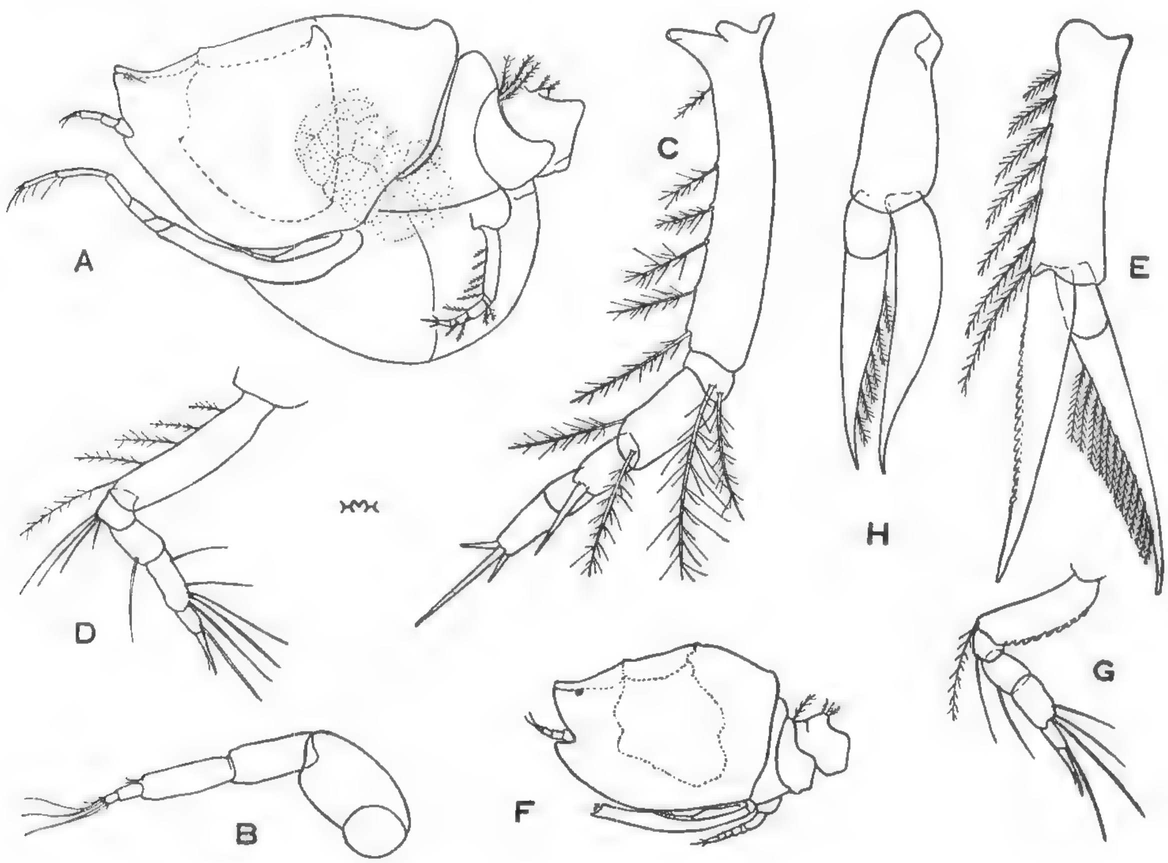

Fig. 43. *Cyclaspis usitata,* newly moulted, transparent adult female; A, cephalothorax; B, first antenna; C and D, second and fourth peraeopods; E, uropod. Juvenile, 2·3 m.m.; F, cephalothorax; G, fourth peraeopod; H, uropod (A, × 16; B, C and G, × 72; D and E, × 45; F, × 26; H, × 116).

The anterior transverse carina is distinct and is elevated medianly to form a small dorsal tooth; thence as it continues downwards on each side it crosses two low tumidities which are slightly concave immediately in front of the carina, so that a tooth-like prominence results. In some cases the upper of these projections is angular and almost spine-like. The "blunting" of these features in the type female may be due to age.

In lateral view the profile of the narrow ocular lobe is straight; thence the dorsal outline rises obliquely to the first transverse carina, but is quite unbroken by tooth or tubercle; between the two transverse carinae the margin is very slightly concave and posterior to it is arched upwards and downwards; at the hinder end of the back the median conical elevation is large.

In dorsal view the carapace is of equal width where crossed by the transverse carinae.

The stout uropods are less than twice as long as the telsonic somite; the peduncle is a little shorter than the endopod, which is slightly longer than the exopod, and six times as long as wide.

Colour yellow.

Length to 7 mm.

Juveniles, about 2·3 mm. in length, are similar to young of *tribulis*, but the carapace lacks a post-ocular dorsal projection; the characteristic ridging of the carapace is pronounced, but the posterior median elevation is low and as usual the appendages are stouter and relatively shorter than in the adult.

The peduncle of the uropods is stout, much shorter than the rami, which are relatively wider than in older examples.

Loc. South Australia: St. Vincent Gulf. New South Wales: Jervis Bay.

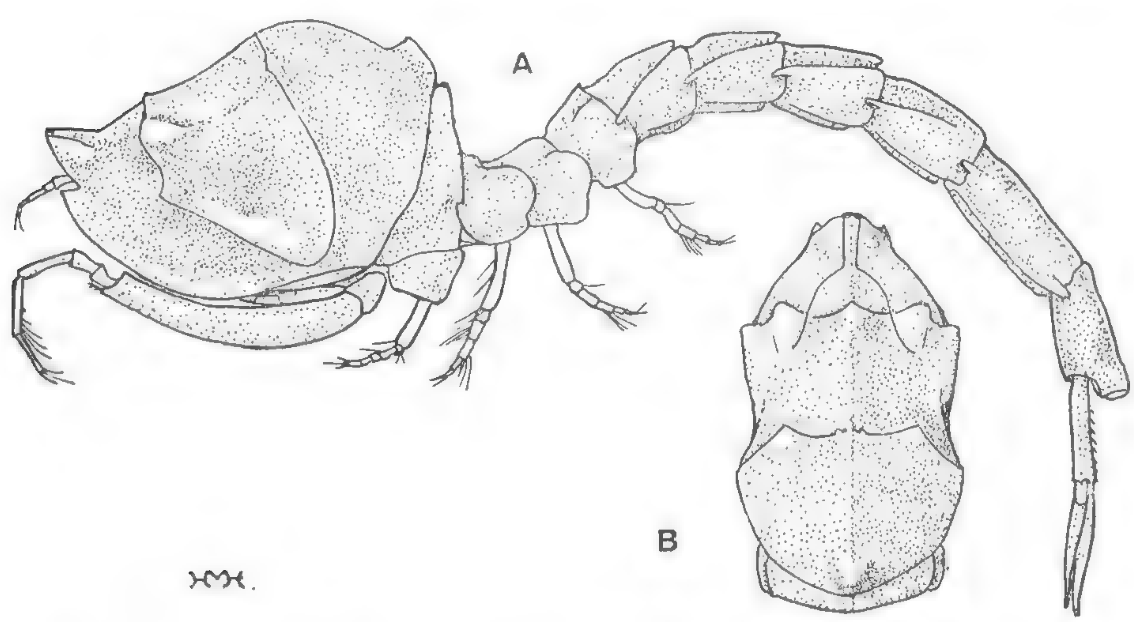

Fig. 44. *Cyclaspis usitata*, subadult female (New South Wales); A, lateral view; B, carapace from above (× 19).

Material attracted to light at Brighton, October 22, 1941, and again in November 1943, consisted largely of subadult and adult females, all of which had recently moulted. They were almost all flaccid, the integument transparent with black pigment spots, and not at all or scarcely calcified, although in some induration was proceeding and the very coarse pitted patterning characteristic of the *exsculpta* group was noticeable. These adult females are smaller than the type (7 mm. as against 10 mm.) and about equal in size to the subadult female from New South Wales which is figured (fig. 44 A and B). The marsupium is fully developed but contains no eggs; the ovaries are swollen with large ova (approx. 0·4 mm.) easily visible through the transparent integument as large, bright yellow masses (fig. 43, A). It may be that, as in some other Crustacea, mating occurs at this period.

Some of the specimens discussed above, females and juveniles, were attracted by green light on November 22, 1941, at 8.15 p.m., and it is worthy of note that at the same place and time Cumacea flocked around the green light in much greater numbers than the ever present Amphipoda, which appeared in overwhelming numbers when a red light was used. A "white" lamp produced practically the same result as the green.

As noted under *mawsonae*, the male of that species swarmed at Brighton on October 13, 1941, a week prior to the swarming of the females of *usitata*.

CYCLASPIS ASPERA sp. nov.

Subadult male. Integument firm, calcified; reticulate and conspicuously spinulose.

Carapace with dorsal margin little arched in lateral view, one-fourth of total length of animal, more than one-half its own length and about two-thirds of greatest breadth. Carapace with four lateral spinose elevations on each side; two are placed at about the first fourth of length close together, the one imme-

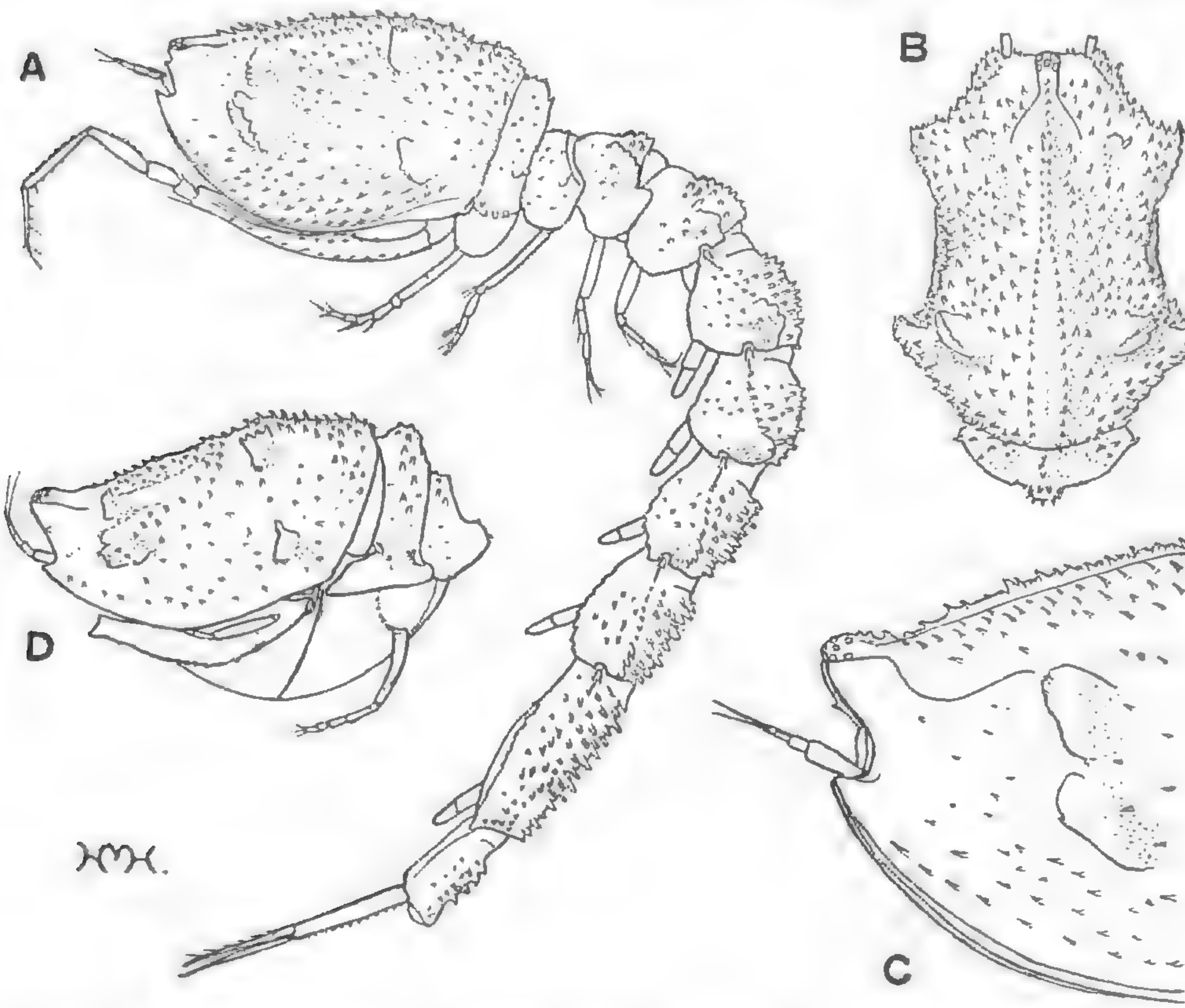

Fig. 45. *Cyclaspis aspera.* A, lateral view of type male. B, carapace of paratype male from above and C, lateral view of front portion of carapace. D, lateral view of carapace and anterior thoracic somites of female. (A, B and D, × 15½; C, × 32).

diately above the other; the other two are situated at three-fourths of the length, one above the other, but widely separated; the side of the carapace has a quadrangular concavity, the four corners marked by the spinose elevations but enclosing ridges are obsolete; in dorsal view the width is greatest across the ventral postero-lateral elevations. Dorsum of carapace with a low, spinose median carina, which bifurcates at level of posterior end of ocular lobe, thence running back as two distinct spinose rows which tend to come together again at posterior end of carapace. Pseudorostral lobes not quite attaining apex of ocular lobe, which is much longer than wide, with small but distinct lenses. Antennal notch distinct, moderately deep, and antennal tooth subacute.

First pedigerous somite concealed; second deep, short and elevated dorsally; fifth longer than third and fourth somites.

First five somites of pleon with well-developed articular processes; all but fifth somite subequal in length.

A median dorsal carina (perhaps better described as a defined series of short median spines) extends along the last three thoracic somites and the pleon almost to the end of the telsonic somite, where it bifurcates; the exposed pedigerous and anterior pleon somites bear lateral expansions; these are merely slight spinose elevations on all but the last pedigerous and first pleon somites, where they form wing-like projections.

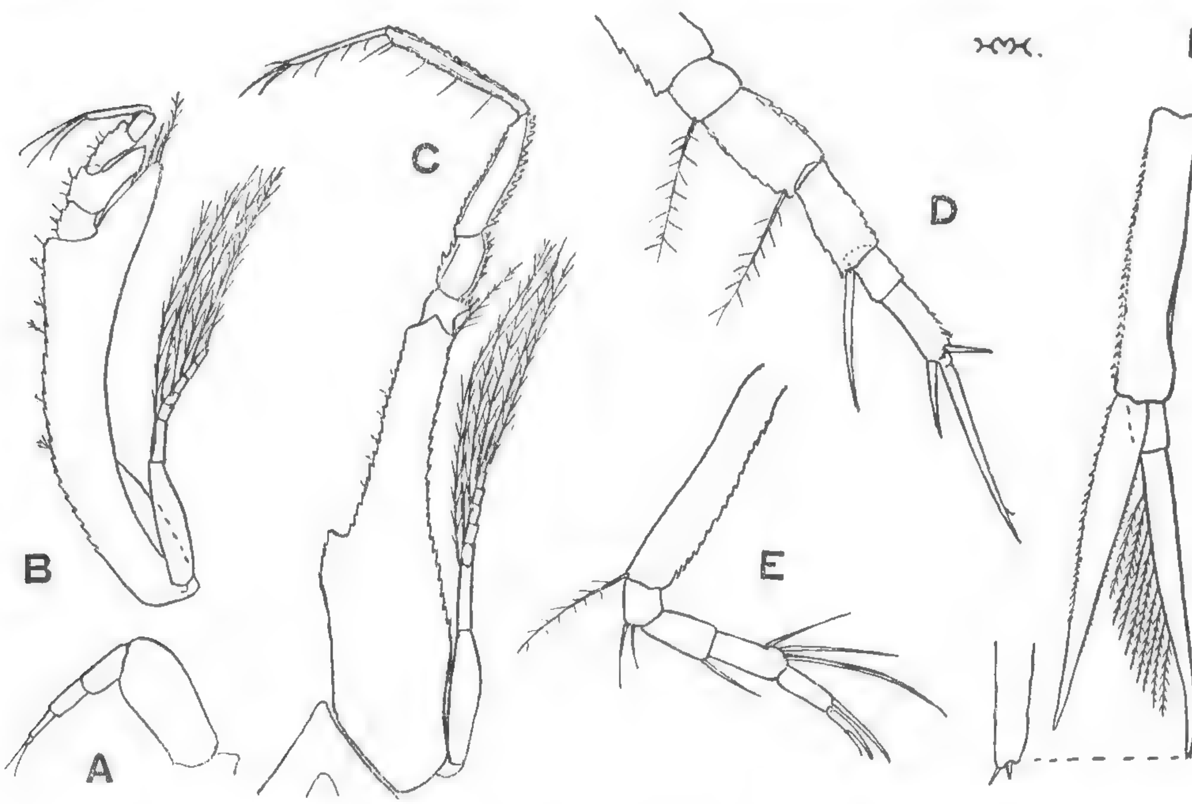

Fig. 46. *Cyclaspis aspera*, type male; A, first antenna; B, third maxilliped; C, D and E, first, second and fourth peraeopods; F, uropod (A and D, × 84; B and C, × 26; E, × 50; F, × 35).

First antennae with second segment stouter and longer than third; second and third together three-fourths as long as stout basal joint.

Basis of third maxillipeds more than twice as long as rest of limb, with outer apical portion reaching forward almost to distal end of merus and capped with plumose setae; carpus as long as the slender dactylus, and twice as long as the propodus; merus, including its apical expansion, as long as carpus and propodus together.

First peraeopod slender, much longer than carapace, its merus reaching forward to level of antennal tooth; basis almost as long as rest of limb, with margins serrate, with a small but distinct apical process, and with a plumose apical seta; merus, carpus, propodus and (to a less defined extent), dactylus with serrated edges; ischium with short spines at outer part of apex; merus half as long as carpus, which is longer than the dactylus and shorter than the propodus.

Basis of second peraeopods longer than rest of limb; merus longer than

carpus and as long as propodus and dactylus together; longest terminal dactylar spine not much shorter than carpus, propodus and dactylus together, the other two unequal.

Last three pairs of peraeopods with basis becoming successively shorter; longer than rest of limb in third, a little shorter in fourth and only as long as ischium merus and carpus combined in fifth; setae see fig. 3, I.

Peduncle of uropods shorter than telsonic somite and serrate on outer side; endopod serrate on inner margin, slender, without apical spine, one-sixth as long again as peduncle and a little shorter than the exopod, which bears slender setae on inner margin and two minute apical mucrones.

Colour milky white, without markings.

Length 9·5 mm.

Ovigerous female. Carapace in lateral view of different shape (c.f. fig. 45, A and D); first pedigerous somite partly exposed and the second relatively longer than in the male.

Loc. New South Wales: off Coffs Harbour, 50 metres (K. Sheard, June 1941). East of Pt. Hacking, trawled on mud, 100 metres (K. Sheard, July 1943). Off Botany Bay, 50–52 fath. ("Thetis" Station 37, Mar. 1898), off Jibbon, 46–55 fath. ("Thetis" Station 38, Mar. 1898). Off Cape Three Points, 34–23 fath. ("Thetis" Station 13, Mar. 1898). Eden, 4 miles off shore, in silt, 70 metres (K. Sheard, Oct. 1943). Type male in South Australian Museum, Reg. No. C. 2376.

The four prominent lateral projections of the carapace and the absence of transverse ridges thereon, the long first peraeopods and the spinose body distinguish this species.

The lateral elevations are more spinose or more acute in some examples than in those illustrated; the upper and lower antero-lateral elevations are often conjoined on each side, but still retain their character as distinct projections.

CYCLASPIS AUSTRALIS Sars.

Cyclaspis australis Sars, 1887, p. 12, pl. i, fig. 1–20; Calman, 1907, p. 7, Stebbing, 1913, p. 38.

Sars' types from Victoria were subadult. A considerable series now available makes it possible to amplify the original description.

Ovigerous female (8 mm. to 9 mm.). The carapace is about two-thirds as long as deep; in dorsal view it is widest in posterior half where it is three fourths to five-sixths as long as the medial length. The median longitudinal carina bears a double row of small tubercles. At the first fourth of its length, each side of the carapace has two low antero-lateral tubercles, from the lower of which runs downwards and backwards an obsolete ridge. Behind the middle of the length is a transverse carina (much more defined than the anterior) running from the median ridge a little forwards, then forming a decided angle (postero-lateral tubercle) with its curved lateral continuation, which meets the feeble anterior carina near the inferior margin of the carapace; a low, oblique, swollen dorso-lateral ridge extends from the postero-lateral prominence to the antero-lateral tubercles. The pedigerous and pleon somites are as described by Sars.

The surface is pitted, with the edges of the pits raised to form an ill-marked reticulate pattern. In certain lights these define a faint antennal ridge.

In the first peraeopods the basis is distinctly longer than the rest of the limb and bears a seta at external apical angle and a shorter one at inner angle; the carpus is shorter than the propodus (of equal length in Sars' fig. 16) and longer than the dactylus.

The second leg has the basis as long as the remaining joints, the merus longer than the carpus or propodus, which are subequal in length. Setae of posterior peraeopods as in fig. 3, I.

The peduncle of the uropoda is as long as the telsonic somite and as the exopod, which is slightly longer than the endopod.

Submature examples have the usual characters of immaturity, the peduncle of the uropods is shorter than the rami, etc. In some examples of both sexes, about 8 mm. long, the ridges and elevations of the carapace are more defined and the surface is coarsely reticulate (fig. 48 D-E).

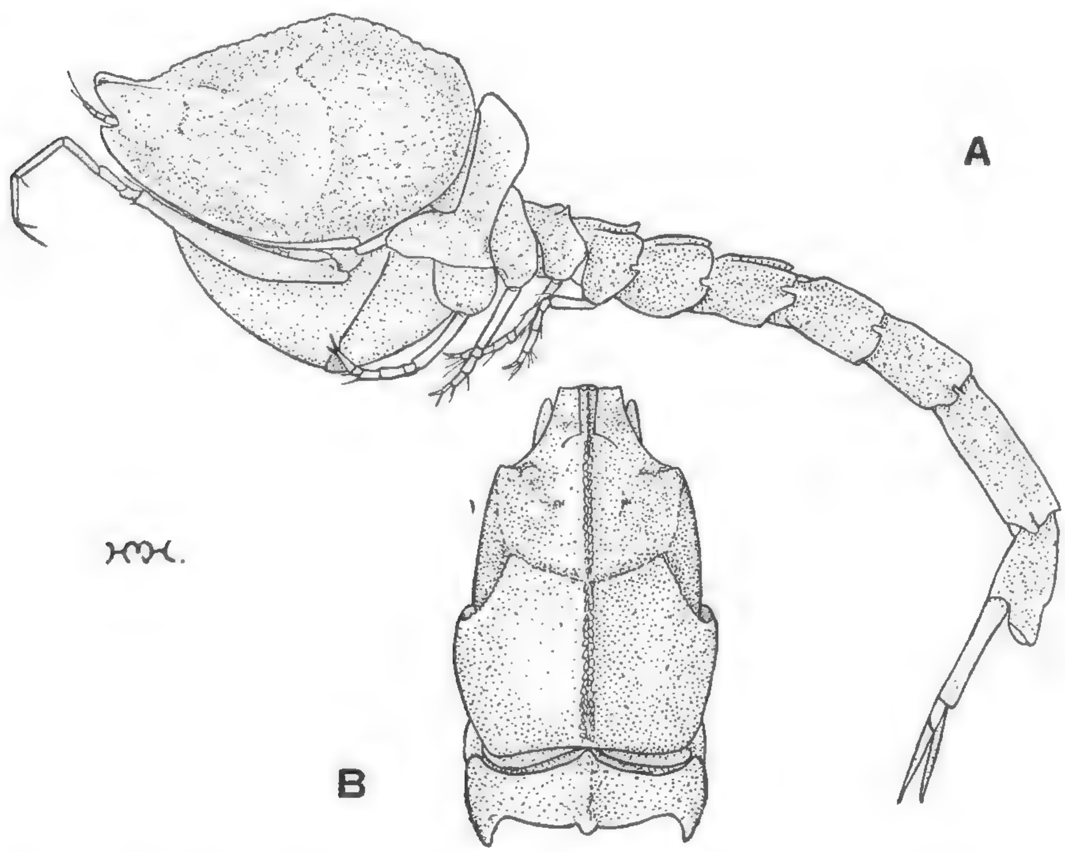

Fig. 47. *Cyclaspis australis*, ovigerous female; A, lateral view; B, carapace from above (× 15).

Loc. Tasmania: Off Babel Is., 0–50 metres ("Warreen" Station 29, 1939). New South Wales: Off Wata Mooli, 35 metres, on sand (Trawl Station 2, July 1943); off Jibbon 70, 40 and 45–50 metres (Trawl Stations 3, 6, 9 and 10, July-Aug. 1943); 5 miles east of Pt. Hacking, 100 metres, on mud (K. Sheard, July 1943); off Cape Three Points, 41–50 fath. ("Thetis" Station 13, Feb. 1898); Eden, 4 miles off shore, in silt, 70 metres (K. Sheard, Oct. 1943).

Hab. Victoria, Tasmania and New South Wales.

In his key to *Cyclaspis* spp. Stebbing (1913, pp. 29–30), from Sars' description, separates *australis* from *exsculpta*, etc., in having "Ridges not enclosing quadrilateral areas on carapace." These areas are present though faintly marked.

In the grouping here adopted, this species has a quite characteristic facies; considering both adults and subadults, it has the sculpturing of the carapace less

marked than in other members of the *exsculpta* group. The elevations, or ridges, bounding the subtriangular depression on the sides of the carapace are not so distinctly defined. The posterior transverse ridge is, however, very definite; the anterior one is traceable but does not meet its fellow on the back to form a dorsal transverse ridge, nor is there at this level a dorsal prominence.

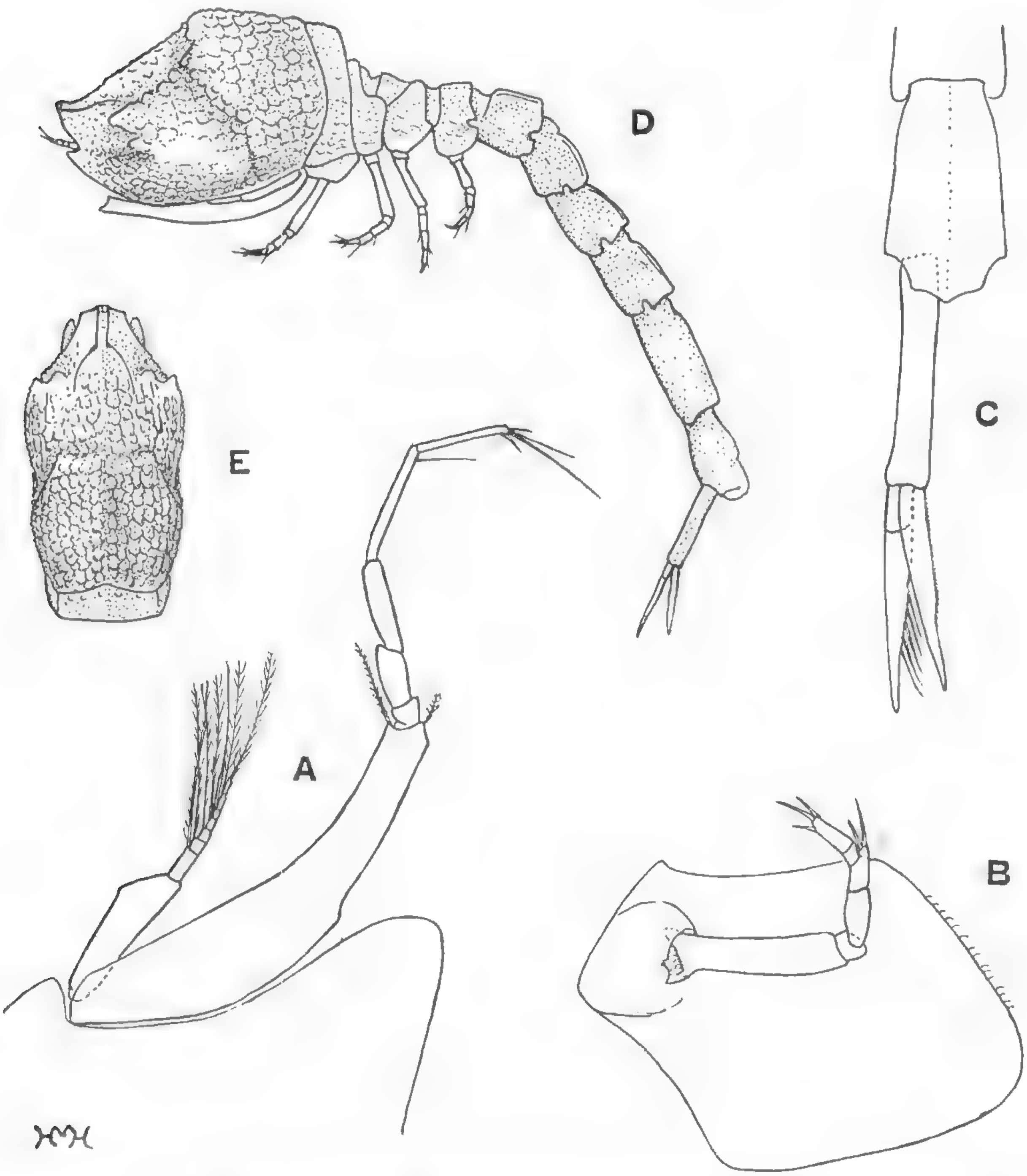

Fig. 48. *Cyclaspis australis*, ovigerous female; A and B, first and second peraeopods; C, telsonic somite and uropod (× 26). Submature, coarsely reticulate female; D, lateral view; E, carapace from above (A to C, × 26; D and E, × 15).

Miscellaneous Species.

The remaining six "sculptured" Australian species form a varied assemblage; the female is known only in *sabulosa*, which makes it still more impossible to group them satisfactorily.

C. simula alone has a long ridge running back from the antennal tooth, as well as other longitudinal ridges on the sides of the carapace, and has the dorsal and lateral contours of the carapace broken and uneven owing to the sculpture.

C. cana, munda and *pruinosa* all have the general form of the carapace as in the fully adult male of *tribulis* and *mawsonae* (with the greatest width across the pseudolateral lobes) but the sculpture is entirely different; the female of these species should prove of interest.

C. sabulosa and *spilotes* have each side of the carapace relatively smooth, the single forwardly curved ridge being not at all prominent; it is obsolete for the greater part of its length in the female of the first-named. *C. spilotes* (Hale, 1928, p. 36, fig. 5–6) has a sharply defined, fine ridge traversing the side.

Cyclaspis simula sp. nov.

Young male. Integument firm, but of egg-shell fragility; finely and evenly squamose throughout.

Carapace in lateral view with dorsal margin slightly elevated posteriorly,

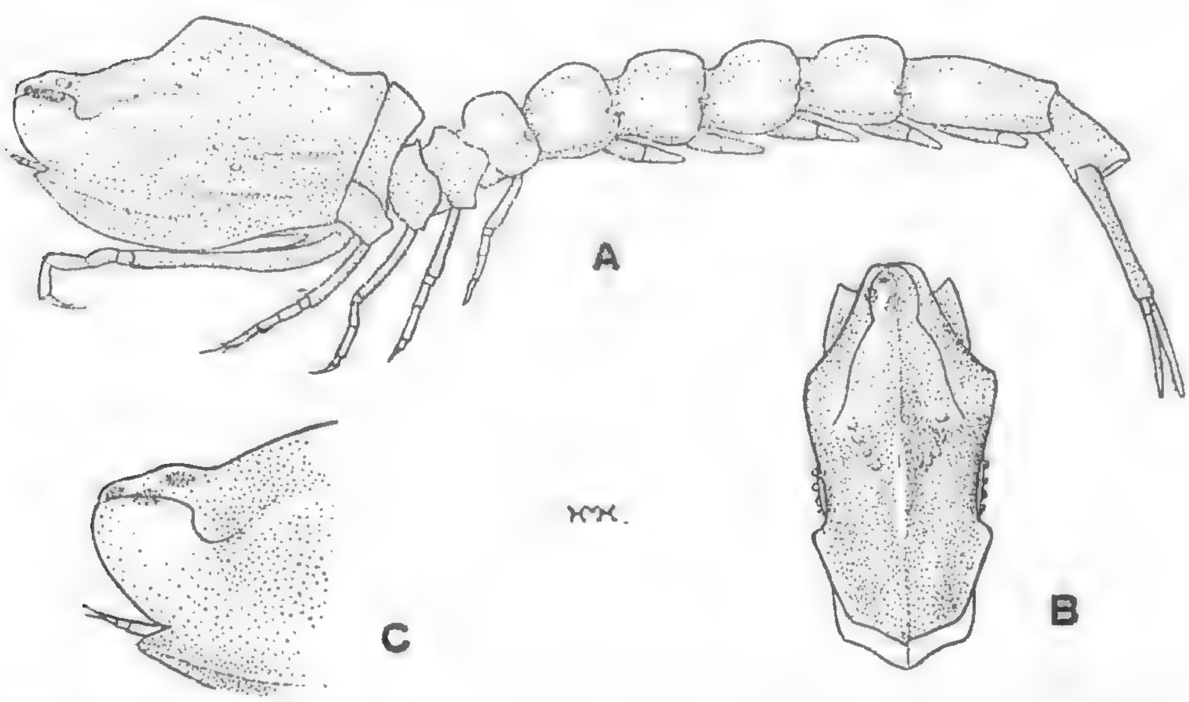

Fig. 49. *Cyclaspis simula*, type male; A, lateral view; B, carapace from above; C, front portion of carapace from the side (A and B, × 30; C, × 53).

thence rising to an abrupt peak at about middle of length (see fig. 49, A); one-third of total length of animal, depth about two-thirds length, and one-fifth greater than breadth; there is a somewhat angular, antero-lateral tumidity on each side, and above this a series of four tubercles; on the lower half of the side and near the posterior margin are two short carinae, one above the other, while from the antennal tooth a longer carina curves backwards to almost meet the lower of the short carinae; there is a group of four tubercles in front of the upper short carina. Pseudorostral lobes reaching to end of ocular lobe. Ocular lobe large, barely longer than wide; lenses sooty. Antennal notch rather narrow and tooth subacute.

First pedigerous somite concealed; second to fifth each with sharp dorsal carina; inferior postero-lateral angles of fifth somite rounded like those of first four pleon somites.

All pleon somites with sharp dorsal carina; somites one to five with well-developed articular processes; first to fourth and telsonic somite subequal in length; fifth one-half as long again.

Third maxillipeds with basis twice as long as rest of limb, with outer apical lobe extending forward to level of insertion of carpus; merus with outer apical lobe extending to a little beyond external apical angle of carpus; ischium a little shorter than carpus and slightly longer than propodus, which is one-half as long as merus.

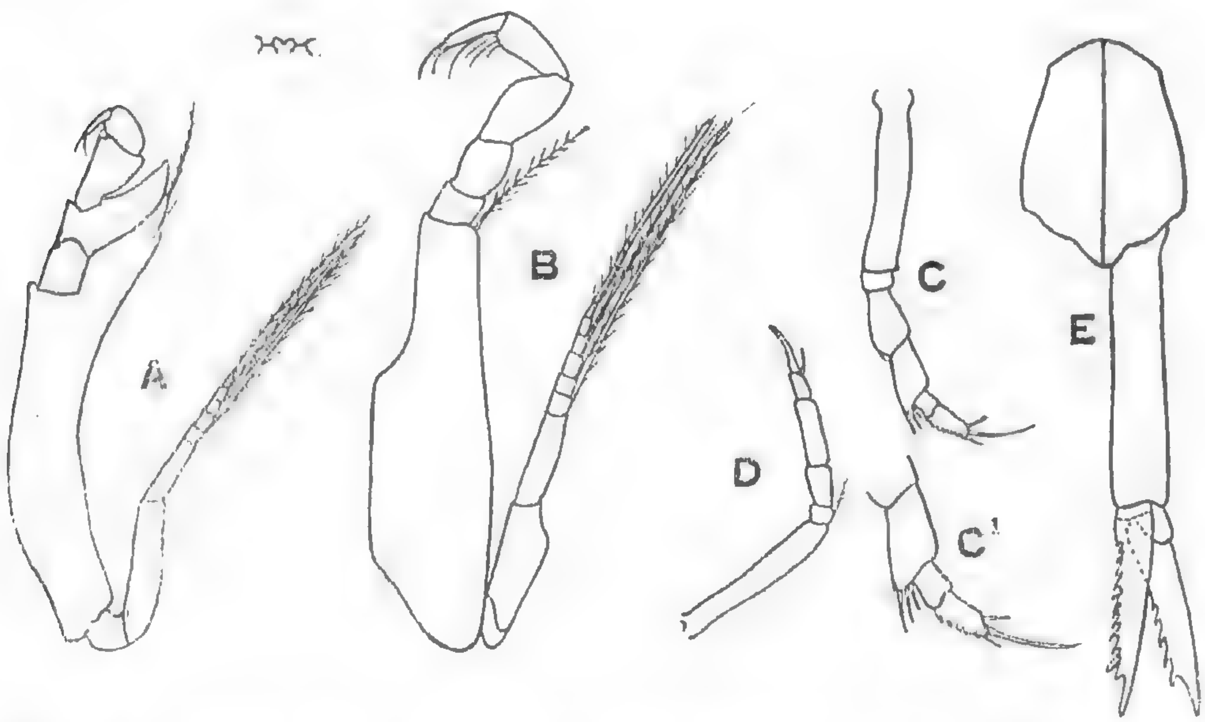

Fig. 50. *Cyclaspis simula*, type male; A, third maxilliped; B, C and D, first, second and fifth peraeopods; C^1, terminal joints of second peraeopod; E, telsonic somite and uropod. (A to E, × 60; C^1, × 86).

First peraeopods only about as long as carapace; basis with a long plumose seta at external apical angle and more than one-fourth as long again as the remainder of limb, the segments of which are stout; ischium little more than half as long as merus, which is equal in length to dactylus and shorter than propodus, which is shorter than carpus.

Second peraeopods with basis as long as rest of limb; ischium and propodus short; merus and carpus much longer and subequal in length; merus with an apical spine and carpus with three, all unusually short; dactylus stout, with three terminal spines, the middle very much longer than the others. Third to fifth peraeopods as in fig. 3, B; one short plumose seta on basis, and one unusually short seta on propodus; no other armature.

Peduncle of uropods about one-fourth as long again as telsonic somite; rami equal in length, three-fourths as long as peduncle, rather broad, apically simple and acute, inner edges coarsely serrate.

Colour milk white, without any dark pigment.

Length 3·9 mm.

Loc. South Austalia: Page Is., 9 fath. (K. Sheard, submarine light, April 1941, 7 to 7.30 p.m.). Type in South Australian Museum, Reg. No. C. 2331.

CYCLASPIS CANA sp. nov.

Adult male. Integument strongly calcified.

Carapace small, less than half length of pleon and about one-fourth of total length; a little more than twice as long as depth, which is slightly less than greatest width; dorsal margin in lateral view scarcely at all arched; surface not pitted,

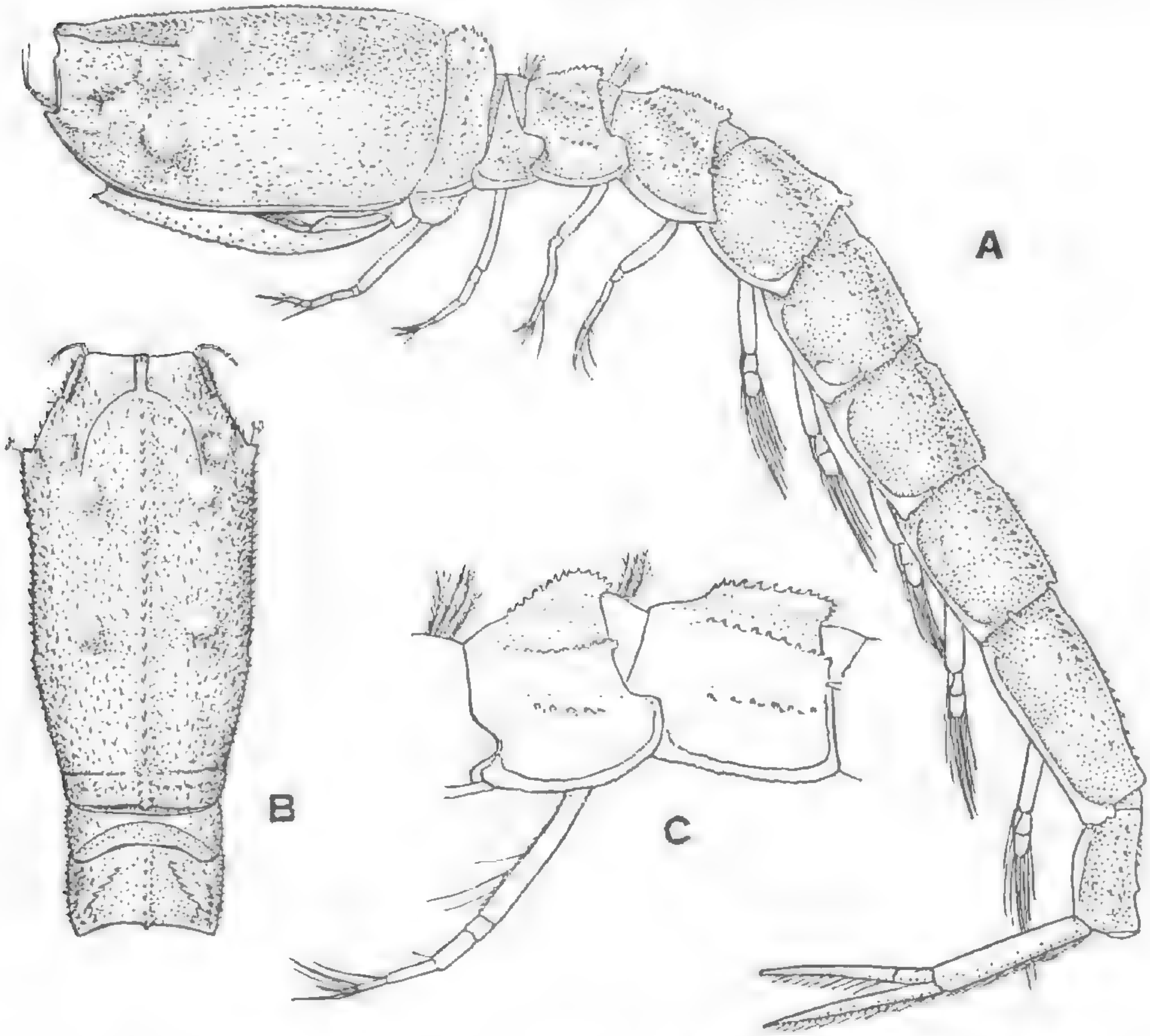

Fig. 51. *Cyclaspis cana*, type male; A, lateral view; B, carapace and first four pedigerous somites from above; C, fourth and fifth pedigerous somites from the side. (A and B, × 15½; C, × 32).

with very fine reticulate pattern, and with minute sparse spinules; there is a well-marked, spinose, median longitudinal carina for whole length and a short groove leading back from the antennal notch; on each side are four rounded tubercles, one (upper antero-lateral tubercle, from which extends obliquely forward an obsolete spinose ridge) on the hinder portion of the pseudorostral lobe, one below this, one immediately behind the termination of the pseudorostral lobe, and one at same level, at two-thirds of length; a feeble infero-lateral tubercle is also

present. The carapace is widest across the lower of the anterior tubercles. Pseudo-rostral lobes not meeting in front of ocular lobe. Antennal notch wide and angle subacute. Ocular lobe narrow with distinct lenses.

Exposed pedigerous somites, with exception of third somite which is extremely short dorsally, each with a spinose carina; on the fourth and fifth this is raised to form a thin serrated crest, below which is a spinose dorso-lateral oblique ridge.

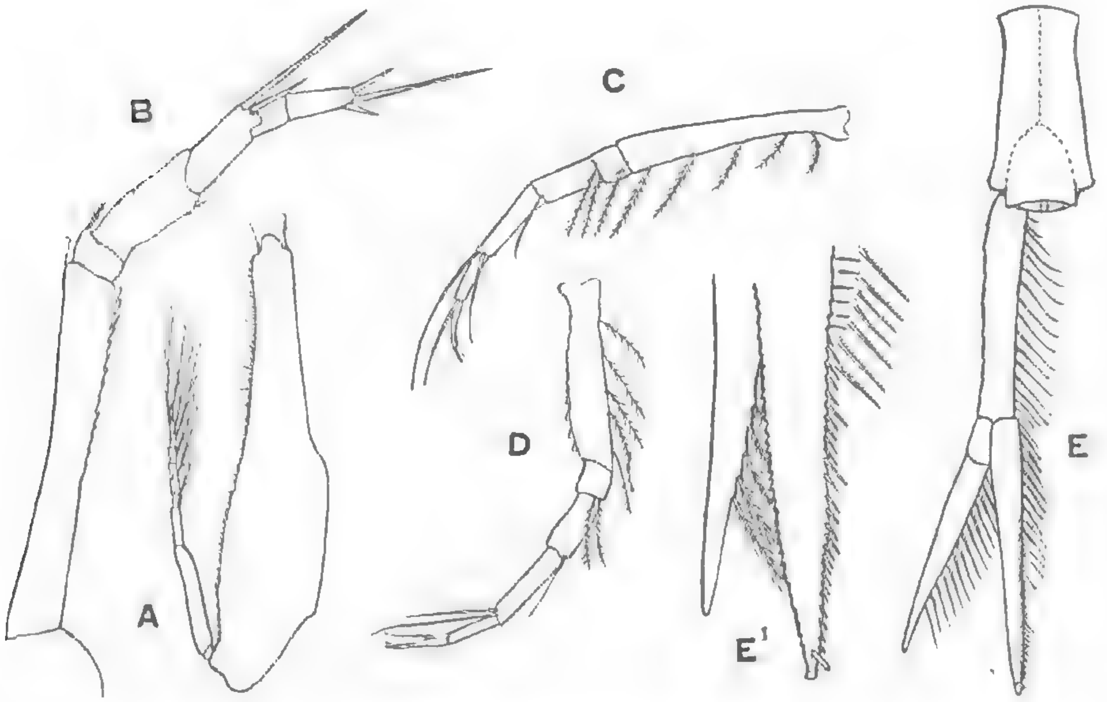

Fig. 52. *Cyclaspis cana*, type male; A, basis of first peraeopod; B, C and D, second, fourth and fifth peraeopods; E, telsonic somite and uropod; E1, terminal half of rami of uropod. (A and E, × 25; B and E1, × 64; C and D, × 40).

First to fifth pleon somites each with a median carina, a spinose dorso-lateral carina on each side, and a few scattered spinules; each of the three ridges terminates in a small projection at the hinder margins of the somites; telsonic somite with a median carina, which bifurcates at two-thirds of length, an elevation marking the point of separation.

Basis of first peraeopods with two apical plumose setae (rest of limb missing).

Second peraeopod with basis little longer than remaining joints together; merus fully as long as propodus and dactylus together, and longer than carpus; dactylus with terminal spine (which is flanked by two much shorter spines) longer than merus; apex of carpus with a still longer spine, and one which is half as long (fig. 52, B).

Third to fourth peraeopods slender, with long subterminal setae, two being on carpus (fig. 3, G), which is unusually elongate.

Uropods with endopod a little longer than exopod, which is subequal in length to peduncle, and to telsonic somite; inner margin of peduncle with slender setae; endopod with a comb-like series of spines at middle of length of inner edge, followed by a row of stouter downwardly directed spines and preceded and partly overlapped by finely-serrate long setae; there is a separate short, stout spine near

the narrowly subtruncate apex of the endopod and the outer margin is serrate; exopod has the apex subacute and the inner margin bears long plumose setae.

Colour gray, darker on carapace.

Length 11 mm.

Loc. New South Wales: east of Port Hacking, 100 metes, on mud (Cronulla Trawl Station, July 1943). Type male in South Australian Museum, No. C. 2396.

CYCLASPIS MUNDA sp. nov.

Adult male. Integument calcified, with moderately coarse reticulation and with larger, irregular squamose-tuberculate surface markings.

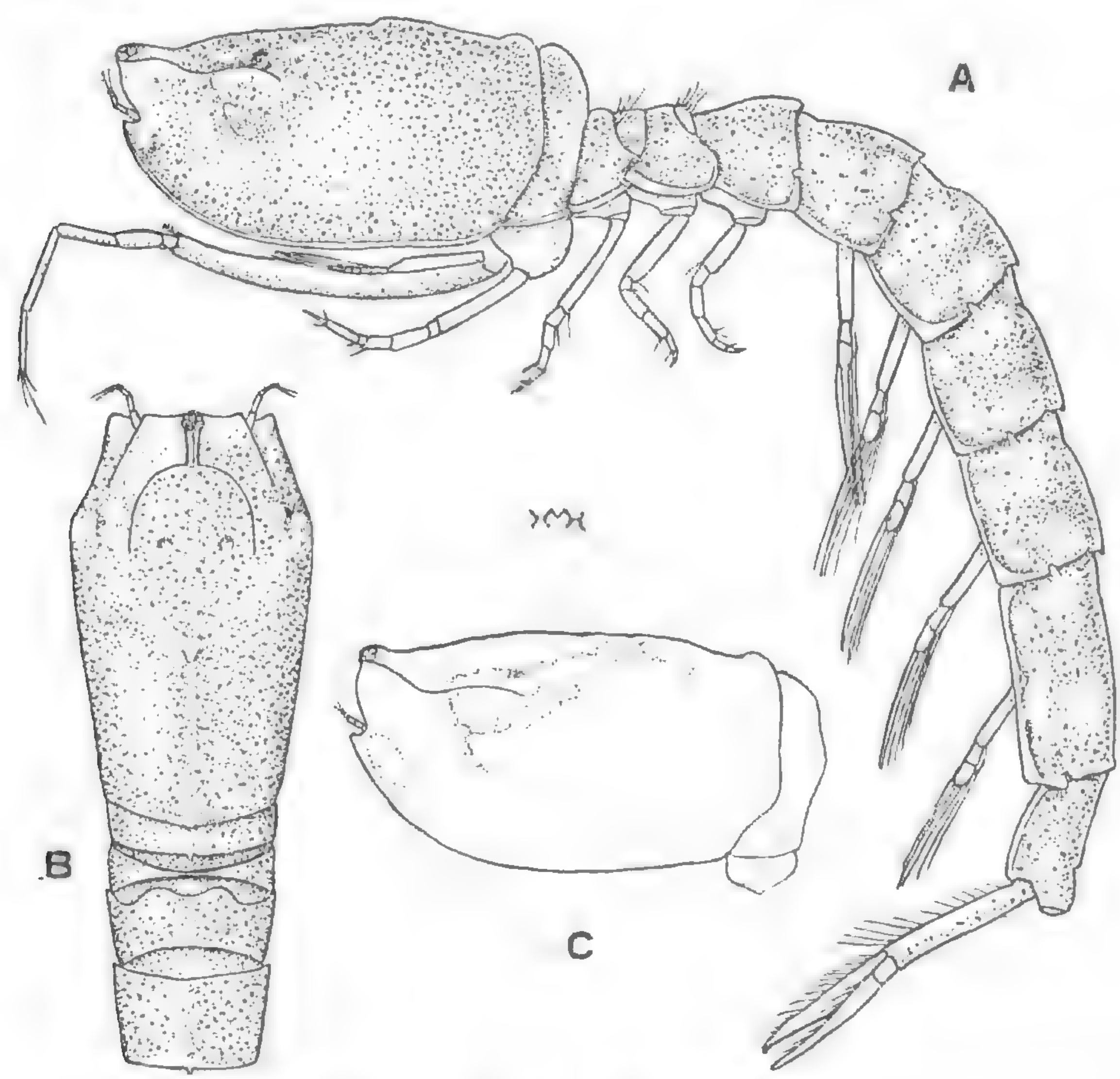

Fig. 53. *Cyclaspis munda,* type male; A, lateral view; B, cephalothorax from above. C, Lateral view of carapace of paratype male (× 19).

Carapace two-sevenths of (three and one-half times in) total length, less than twice as long as depth which is equal to greatest width; dorsal margin in side view little arched, with a slight depression behind middle of length and with a low elevation at posterior end; there is a faint, double, median carina, which becomes single on ocular lobe; from the aforementioned interruption in the dorsal outline there runs obliquely forward an obsolete ridge, below which is a second

and still less easily discernible ridge; below the posterior portion of each pseudo-rostral suture are two confluent antero-lateral tubercles, one below the other; the carapace is widest across the lower of these tumidities. Pseudorostral lobes not meeting in front of ocular lobe. Antennal notch wide and shallow; angle somewhat obtuse, with a small oval tumidity behind it. Ocular lobe narrow, with a mulberry-like mass of prominent, pigmented lenses at anterior end.

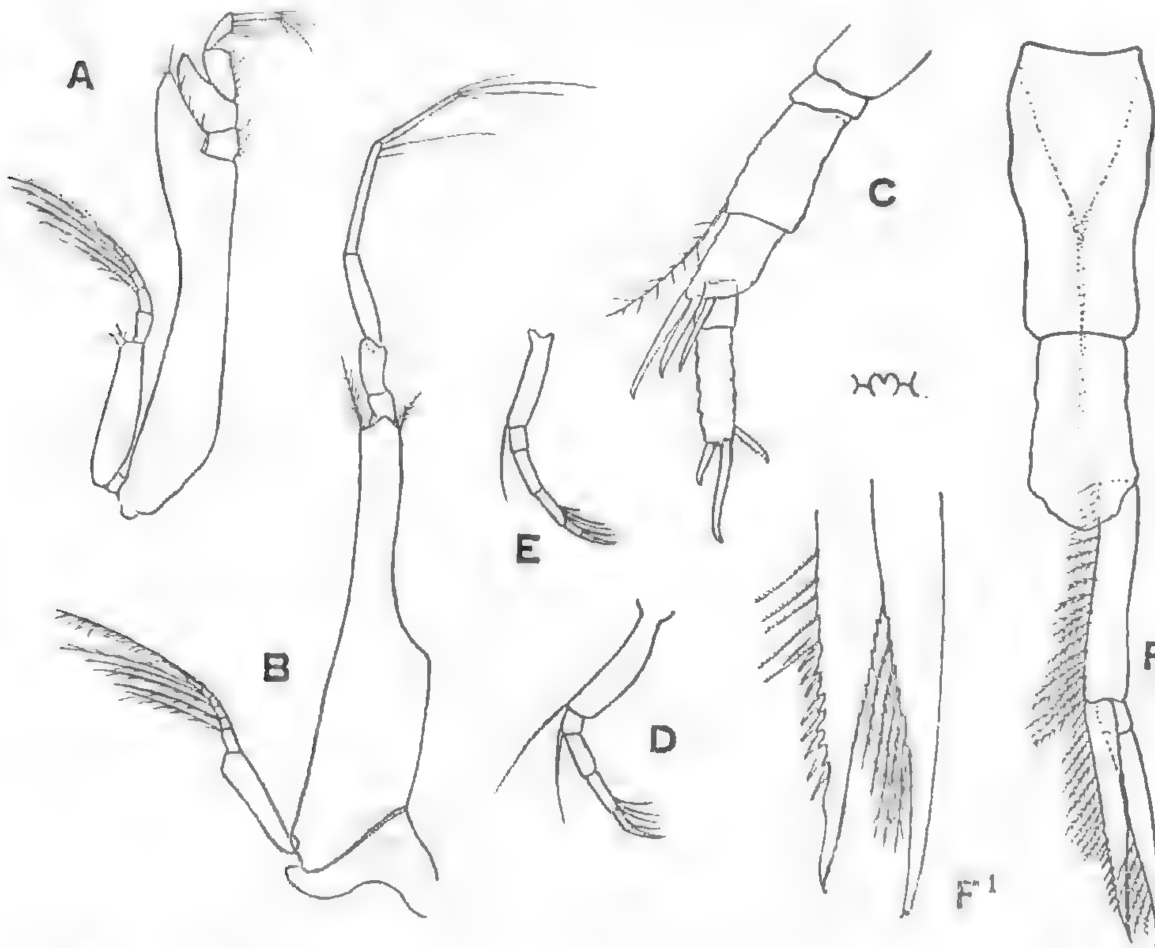

Fig. 54. *Cyclaspis munda*, type male; A, third maxilliped; B, C, D and E, first, second, fourth and fifth peraeopods; F, fifth pleon and telsonic somites, and uropod; F1, terminal half of rami of uropod (A, B, D, E and F, × 32; C and F1, × 80).

Pedigerous somites two and five with a median carina which is produced as a little tubercle at posterior margins; fourth with a very faintly marked, double median ridge, not produced at hinder edge; third short dorsally, not carinate.

Sides of pleon somites, unlike leg-bearing ones, tumid fore and aft when seen from above; first to fourth somites each with a median ridge, evanescent anteriorly but slightly produced at hinder end of somite; fifth with a median carina on posterior third, bifurcating anteriorly to form a pair of divergent dorso-lateral carinae; telsonic somite with a low carina, ending abruptly at two-thirds of length, an incision in the dorsal outline at its termination.

Third maxillipeds with basis and merus produced and widened apically to form prominent lobes; carpus longer than propodus or dactylus.

First peraeopods slender; basis longer than rest of limb, and with two apical plumose setae; carpus a little shorter than propodus, and as long as the narrow dactylus, which is shorter than its longest terminal seta.

Basis of second peraeopods not as long as remaining segments together; merus

longer than carpus and propodus together; dactylus more than twice as long as propodus, longer than its longest terminal spine; merus with a long plumose seta, and carpus with three strong spines on distal margin. Fossorial legs with basis as long as (third) or a little shorter than remaining segments together; setae short, three on carpus as in fig. 3, I. Uropods with rami subequal in length, longer than the peduncle, which is longer than the telsonic somite; endopod with apex acute and slightly curved; both margins serrate, the inner also with a row of eight downwardly-directed spines on posterior third and with serrate setae on anterior two-thirds; inner edge of exopod and peduncle with plumose setae; apex of exopod narrowly rounded, with small mucro.

Colour brown, with darker spotting.

Length 8·75 mm.

Loc. New South Wales: Off Wata Mooli, 35 metres, on sand (Cronulla Trawl Station 2), and off Eden, 30 metres, coarse sand (Cronulla trawled Oct. 1943). Type male in South Australian Museum, Reg. No. C. 2394.

CYCLASPIS PRUINOSA sp. nov.

Adult male. Integument strongly calcified, the body somites with minute spines, giving the animal a hoary appearance.

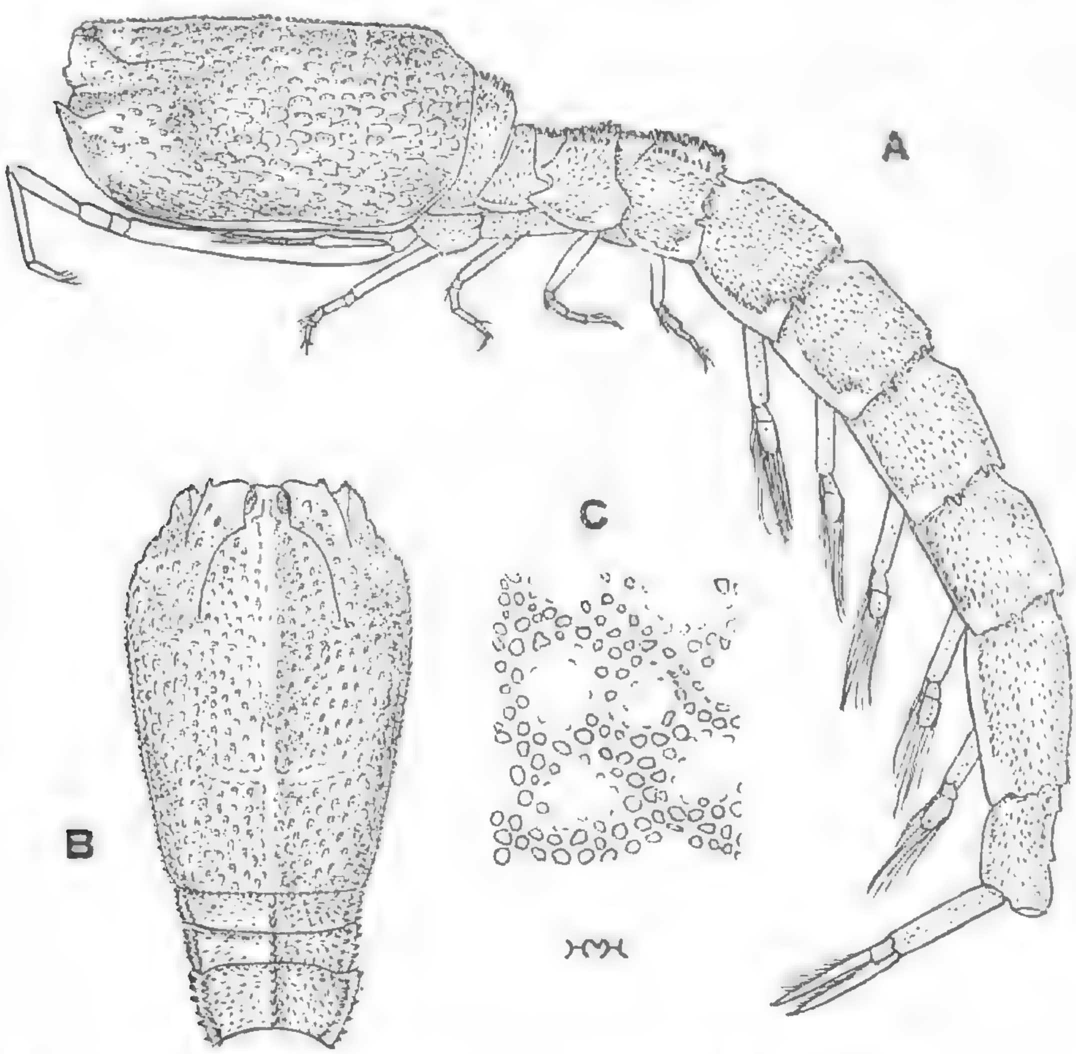

Fig. 55. *Cyclaspis pruinosa,* type male; A, lateral view; B, carapace and second to fourth pedigerous somites from above; C, calcification of carapace (A and B, × 18; C, × 140).

Carapace less than one-fourth of total length and more than twice as long as deep; widest just behind first fourth of length, where it is much wider than deep; dorsal margin in side view not arched and not elevated posteriorly; surface conspicuously pitted; edges of the pits forming a raised reticulate pattern and with minute blunt spines, arranged partly in double rows; there is a low, wide, median longitudinal carina, with margins irregular owing to pitting; at about

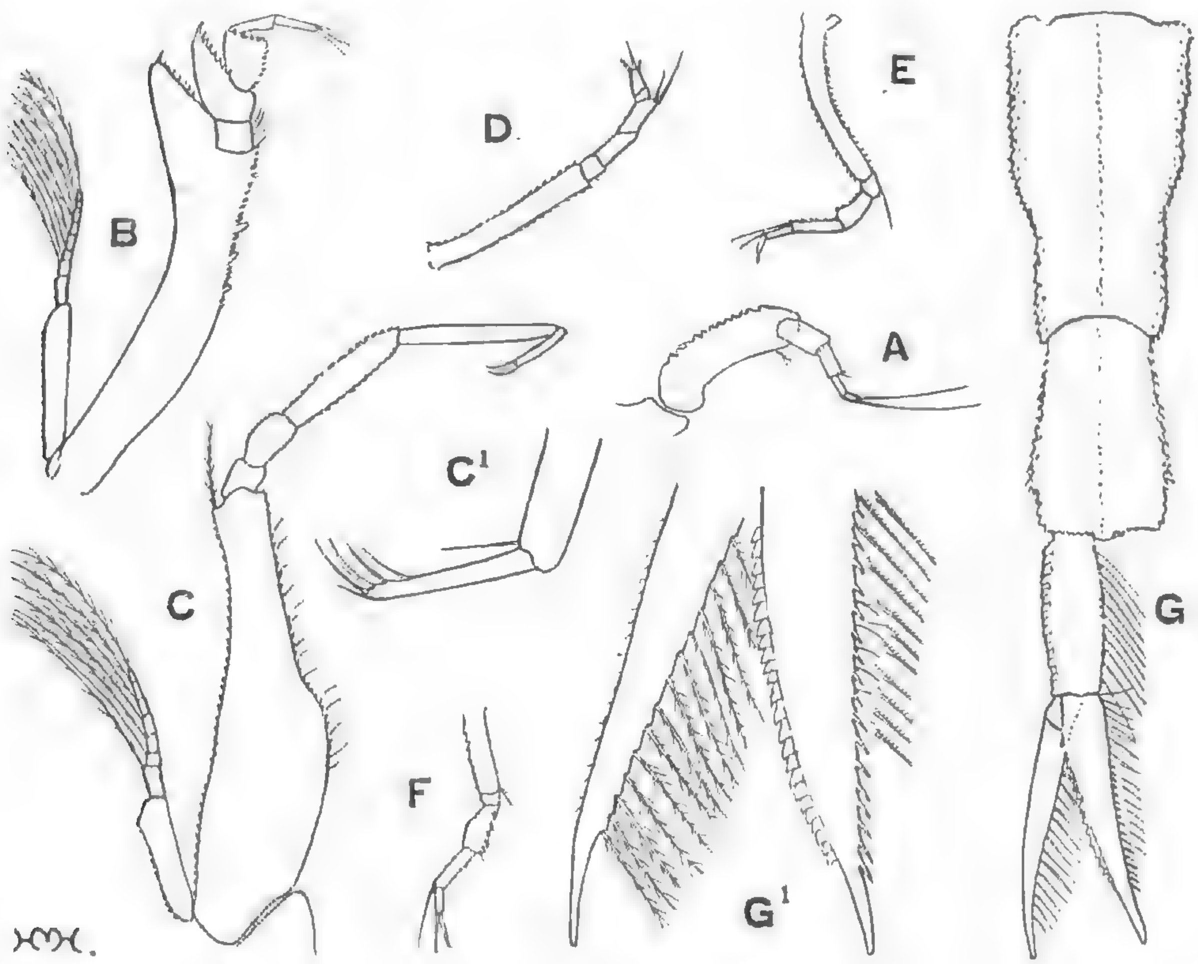

Fig. 56. *Cyclaspis pruinosa*, type male; A, first antenna; B, third maxilliped; C, first peraeopod and C¹, dactylus of same; D to F, second, third and fifth peraeopods; G, fifth pleon and telsonic somites, and uropod; G¹, terminal half of rami of uropod (A, × 50; B to G, × 32; C¹ and G¹, × 84).

two-thirds of its length this carina is crossed by a similar short transverse carina, scarcely elevated and indicated mainly by its freedom from pitting. Pseudorostral lobes barely attaining level of ocular lobe; anterior margin of each with a finely serrated, laminate projection above antennal notch, concealing first antenna when this is directed upwards; from this little lobe a short ridge projects backwards, and below it is an excavation, immediately above the pronounced, acute antennal tooth, which has a finely serrate antero-inferior edge. Ocular lobe as wide as long, with anterior margin bilobed; eye distinct, a mass of pigment on each side of lobe.

Each pedigerous somite with a spinose dorsal median carina and with a dorso-lateral spinose carina on each side, most distinctly developed on the fourth and fifth somites.

Pleon with a median longitudinal carina for whole length; each of the first to fourth somites have six tiny projections at the hinder margin; two are on the dorsum, close together, while there is on each side a dorso-lateral projection larger than the dorsal ones, and one immediately above each articular peg.

First antennae with first segment of peduncle distinctly longer than all the other joints together; second segment as long as third peduncular joint plus the first of the two segments of the flagellum, which bears the usual two filiform terminal appendages.

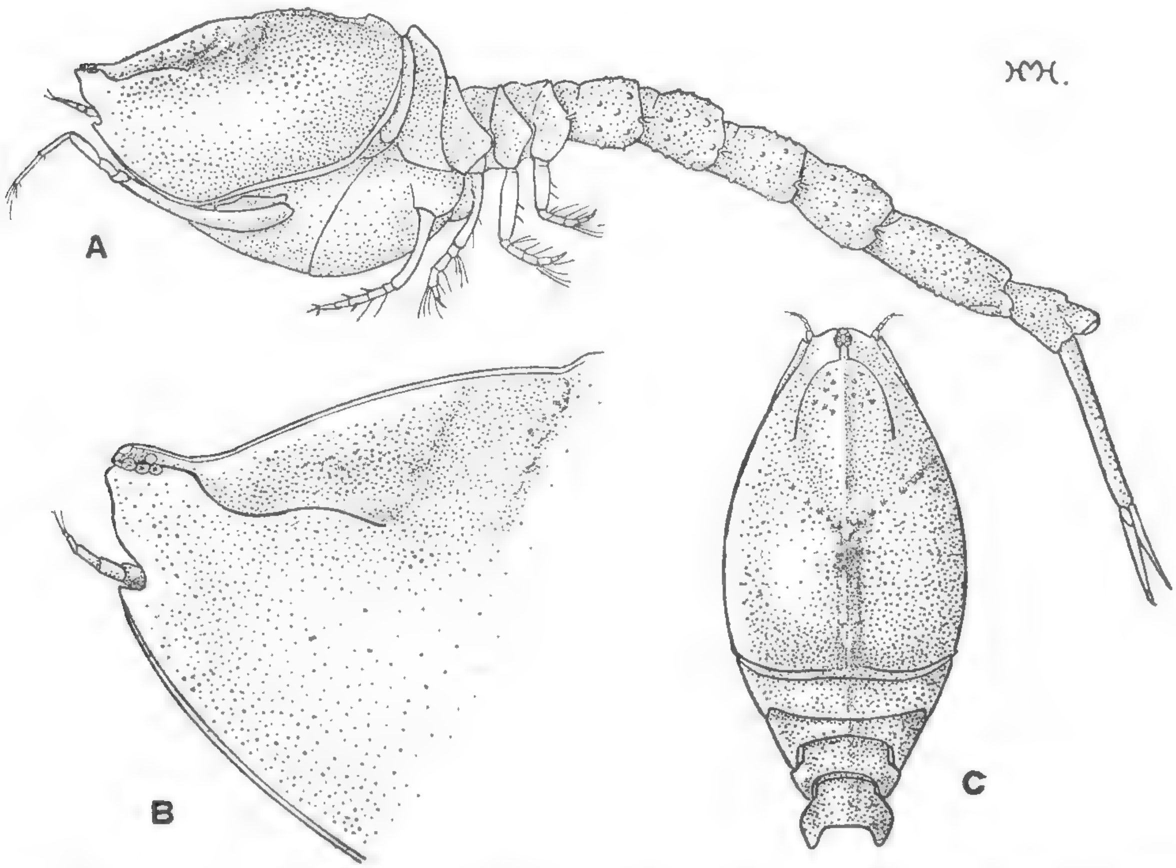

Fig. 57. *Cyclaspis sabulosa,* type female; A, lateral view of whole animal and B, of anterior portion of carapace; C, cephalothorax from above (A and C, × 16; B, × 40).

Third maxillipeds with outer apical portions of basis and merus expanded and produced forwards and with the anterior margins spinose; carpus spinose on apical and inner edges, as wide as long and longer than either propodus or dactylus.

In the first peraeopods the basis is equal in length to the remaining segments together; it bears a plumose seta at outer apical angle and has the margins spinose; carpus stout, with spinose edges, shorter than the much more slender propodus and more than twice as long as the dactylus, which is unusually short, as are its terminal setae (fig. 56, C).

Basis of second peraeopods much longer than rest of limb; merus little longer than carpus, but nearly twice as long as the short and stout dactylus, which is a little shorter than its longest terminal spine.

Basis of third and fourth peraeopods longer than rest of limb, that of fifth shorter; merus shorter than carpus in third and fourth, subequal in fifth; setae sparse and short (see fig. 3, C).

Uropods with exopod barely longer than endopod, but three-fourths as long again as peduncle, which is three-fourths as long as telson and has the margins serrate, the inner with long plumose setae; inner edge of endopod with finely serrate setae and with a long row of about a score of short, stout, downwardly-directed spines; outer edge of endopod serrate; inner edge of exopod with long plumose setae; both rami subacute and simple.

Colour white, pigmentation quite absent.

Length 8 mm.

Loc. Queensland: off Fraser Is., lat. 24° 20′ S.; long. 135° 02′ E., 25 metres. ("Warreen", Sept. 1938, 7.45 to 8.56 p.m.). Type in South Australian Museum, Reg. No. C. 2395.

CYCLASPIS SABULOSA sp. nov.

Ovigerous female. Integument firm, calcified and easily fractured; polished but with a very fine reticulate patterning.

Carapace with dorsal edge arched, incised at middle of length and with a low, abrupt elevation near posterior end; in dorsal view it is ovoid with the sides smoothly rounded; it is a little less than one-third of total length of animal, almost twice as long as greatest depth and much wider than deep. With a median carina, flanked at middle of length by a faint short, tuberculate ridge, oblique, and with

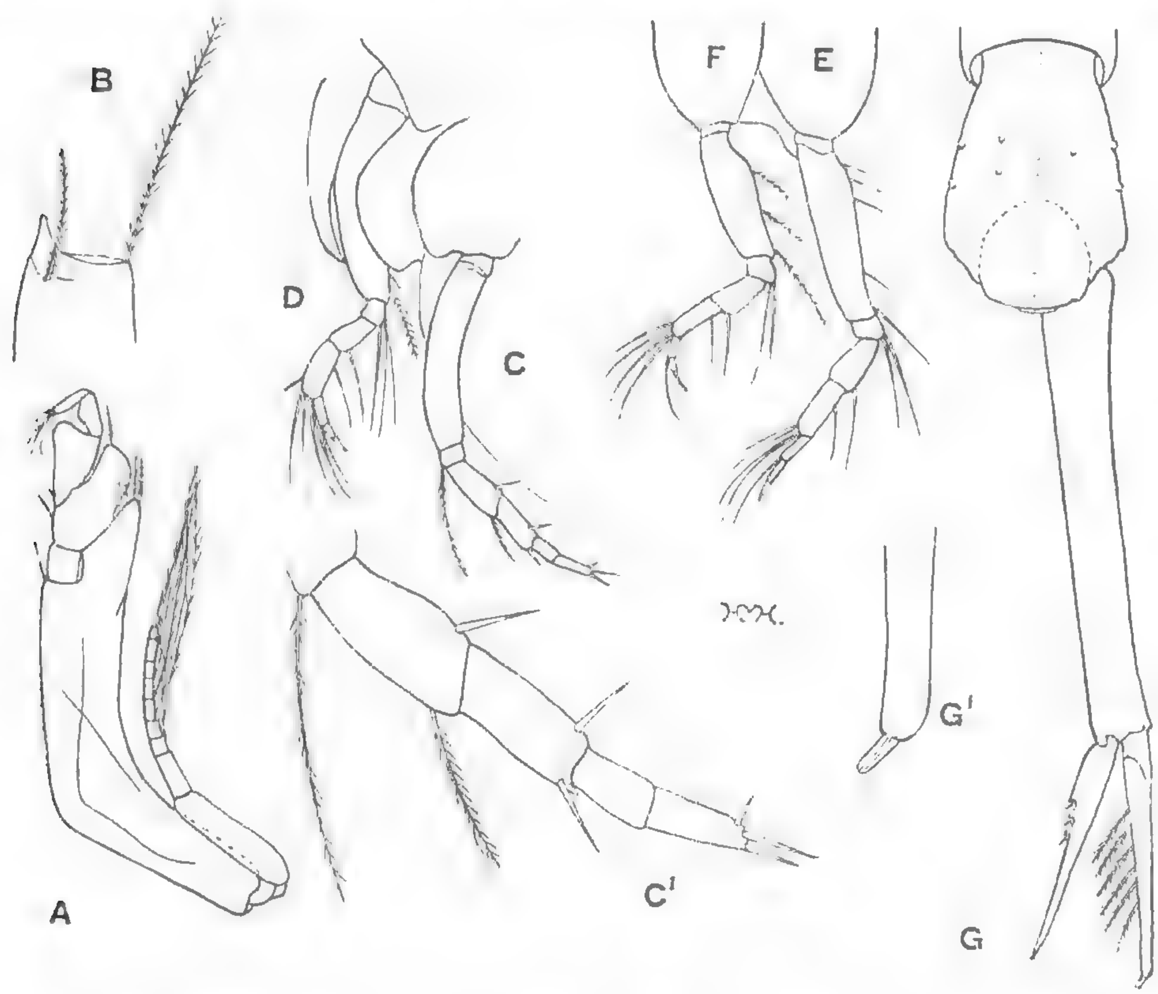

Fig. 58. *Cyclaspis sabulosa*, type female; A, third maxilliped; B, apex of basis of first peraeopod; C to F, second to fifth peraeopods; C1, distal joints of second peraeopod; G, uropod and G1, apex of its exopod with mucro (A, and C to G, × 40; B and C1, × 120; G1, × 175).

a faint tuberculate longitudinal ridge on each side of posterior half; on each side of anterior half is an elongate shallow depression. Pseudorostral lobes not meeting in front of ocular lobe, which is rather narrow with large and partly pigmented lenses. Antennal notch deep and angle subacute, rounded.

Part of first pedigerous somite visible; second to fifth somites each with a low, median dorsal carina; second large, anteriorly elevated to highest level of dorsum of carapace, thence sloping steeply downwards; third short dorsally but expanded backwards infero-laterally; fourth and fifth somites narrower and with sides tumid.

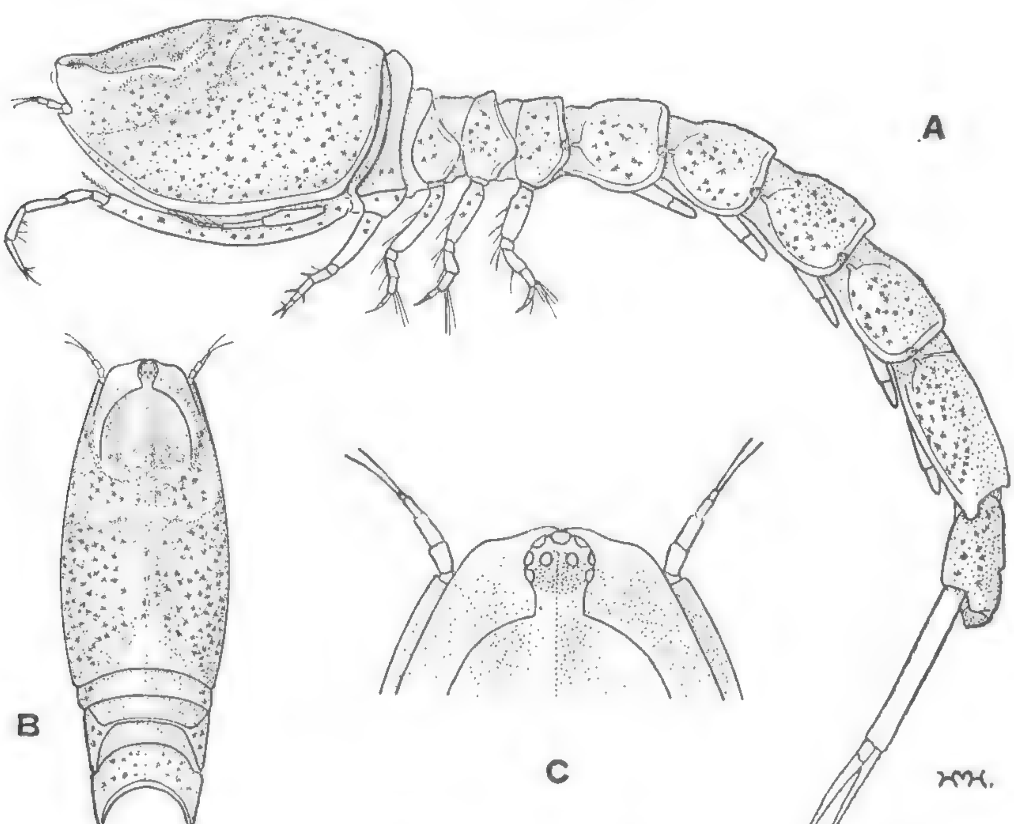

Fig. 59. *Cyclaspis sabulosa*, paratype male; A, lateral view; B, cephalothorax and C, anterior portion of carapace, from above (A and B, × 19; C, × 50).

Pleon somites each with a low median carina and sparsely studded with small tubercles; lateral articular processes well-developed. Telsonic somite with an abrupt dorsal incision at junction of fused telson.

Basis of third maxilliped strongly geniculate, almost twice as long as remainder of limb, with outer apical portion expanded, the large lobe with plumose apical setae; merus wide, with outer lobe reaching distal margin of carpus, which is widest anteriorly and is as long as propodus and dactylus together, but shorter than merus.

First peraeopods with carpus reaching beyond level of antennal angle; basis about one-fifth as long again as rest of limb, with inner apical angle produced forwards to about middle of length of ischium, and with a long plumose seta at external distal angle (reaching to apex of merus), and a shorter subapical seta near inner angle; carpus, propodus and dactylus subequal in length, and to ischium and merus together.

Second peraeopod with basis as long as remaining joints together; ischium

with a long plumose seta; merus a little longer than carpus, as long as propodus and dactylus together, with a slender plumose seta near external apical angle and a spine at inner; carpus with an inner and an outer subapical spine; dactylus not much longer than propodus; the longest dactylar spine and the spines of the merus and carpus are each about as long as propodus.

Basis longer than rest of limb in third legs, equal to it in fourth, and shorter in fifth; carpus longer than merus in all three posterior peraeopods, which have the setae long and well-developed (as in fig 3, K, and 58, C-F).

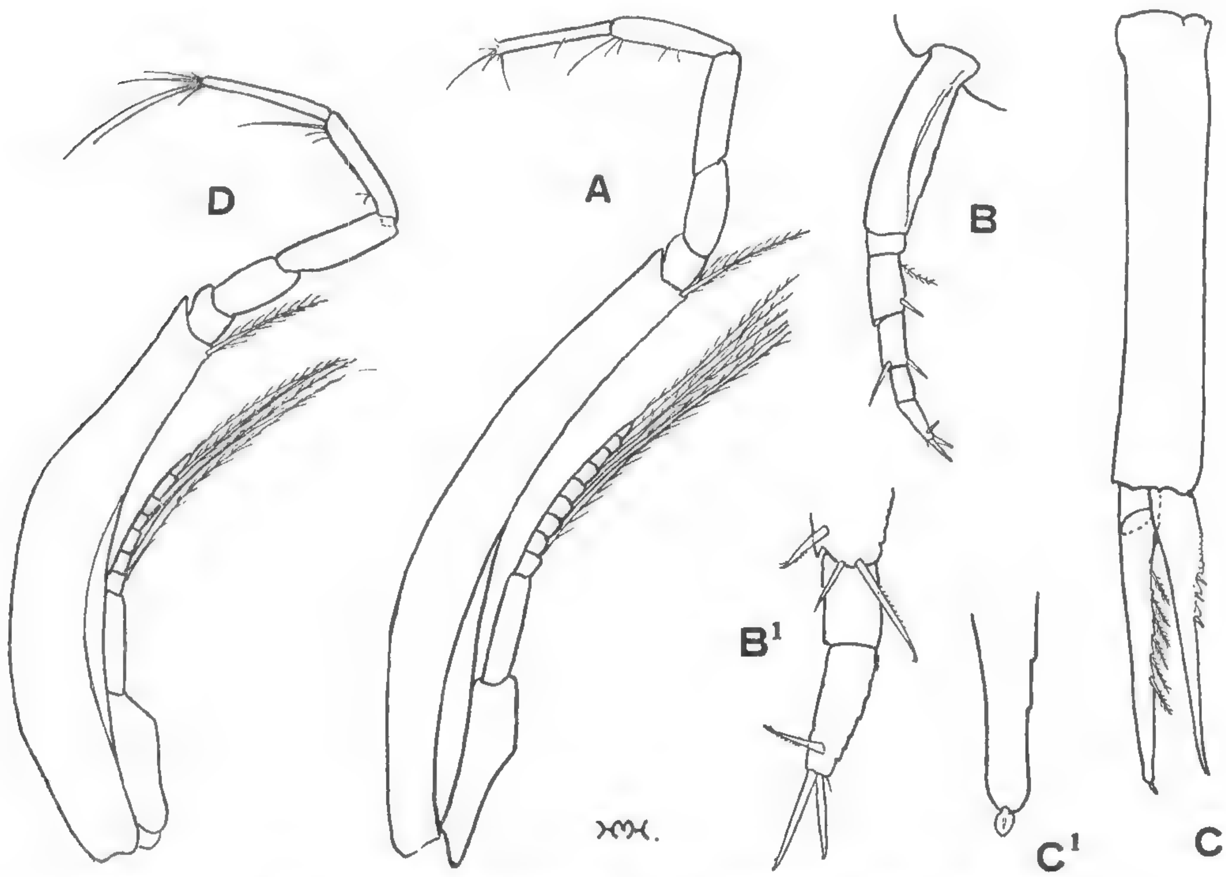

Fig. 60. *Cyclaspis sabulosa,* paratype male; A and B, first and second peraeopods; C, uropod, and C1, apex of its exopod with mucro. D, first peraeopod of paratype ovigerous female (A to D, × 50; B and C1, × 135).

Peduncle of uropoda more than one and three-fourths times as long as telsonic somite; endopod half as long as peduncle, narrow in distal half, apically subacute, with three coarse serrations and inset spines on proximal half of inner margin; exopod slightly longer than endopod with a few setae on inner edge, apex slightly dilated and with a mucro (fig. 58, G).

Colour white, the only trace of colour being provided by a few small pale brown chromatophores on frontal lobe.

Length 7 mm. (Ova ·31 mm. in greatest diameter).

Subadult male. Integument calcified, with reticulate pattern small but distinct.

Carapace considerably less than one-third of total length of animal; length one and two-thirds times depth; in dorsal view it is suboval in shape, narrower than in female, the width being less than the depth. Sides of carapace devoid of outstanding ridges; on each side of median carina a pair of oblique linear

elevations (or very low, rounded carinae) run forwards, as shown in fig. 59, A and B. The depression on each side of the frontal lobe is more marked than in the adult female.

Ocular lobe sub-circular, not much longer than wide, with nine prominent lenses (fig. 59, C). A thin, median carina on pedigerous and pleon somites as in female. First pedigerous somite concealed. Articular pegs of pleon well-developed.

Basis of first peraeopods with apical projection and seta as in female but longer, more than one-fourth as long again as remaining joints together. Carpus of second peraeopods with a subapical and two apical spines.

The peduncle of the uropoda is only one and one-third times as long as the telsonic somite, and the subequal rami about two-thirds as long as peduncle; exopod with six plumose setae on inner margin, its apex bulbous and with a transversely flattened mucro (fig. 60, C).

Colour of body light brown, with numerous small, dark brown chromatophores.

Length 7 mm.

A single male and several ovigerous females.

Loc. New South Wales: off Jibbon, 40 metres and 45–50 metres, on coarse sand (Cronulla Stations 6 and 10, July and Aug. 1943). Types in South Australian Museum, Reg. No. C. 2411 and 2414.

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THE EGG CAPSULE OF THE SOUTHERN AUSTRALIAN BALER SHELL MELO MILTONIS GRAY

BY BERNARD C. COTTON, CONCHOLOGIST, SOUTH AUSTRALIAN MUSEUM

Summary

There has been little research in Australia and indeed in the world, on molluscan eggs and egg capsules. In South Australia many kinds are found washed up on the beach in considerable quantity between the months September and December, and although the specific identities of some have been decided, many are still uncertain. It is desirable that any definite records and identification be published.

In this publication Vol VI, No. 1, November 30, 1937, p. 101, a description of the egg capsule of a Western Australian specimen of Melo miltonis was given. The protoconchs in the capsule were well developed and apparently on the point of hatching, averaging ·26 mm. in length. We have now a record of a South Australian specimen. In November, 1943, Mr. Albert J. Blumson wrote detailing observations made through his glass-bottomed boat and supplying a specimen of the Baler Shell and its capsule taken in South Australia.

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The specimen forwarded is dried and now measures in length 70 mm. and width 70 mm., but according to a photograph taken immediately after the specimen was secured the dimensions would be approximately in length 200 mm. and in width 130 mm. at the widest part near the base. The capsule was taken in fourteen feet of water off Cape Vivonne, near Ceduna, West Coast of South Australia. When first seen in the water it was attached to a fragment of limestone and was in size and shape very much like a pineapple. The surface shone like a piece of opal with iridescent, bright, changing colours. The general surface consisted of numerous individual chambers with a space of about 6 mm. between. In consistency it was about as tough and pliable "as a new motor tyre." The animal responsible for the capsule is a perfect specimen measuring in length 250 mm. and width 140 mm., and is mature, being comparatively thickened towards the outer lip. A further Baler was observed in the process of forming a capsule. When taken by Mr. Blumson the basal layer had already been deposited in the form of a disk on the upper surface of a conglomeration of dead Port Lincoln oyster shells. The Baler clung to the oysters so effectively that they could not be separated by hand. The specimen was placed in a wet bag for later examination. The Baler clung to the oysters for ten hours, and when it finally relinquished its hold it was observed that the bottom layer of ten sections of the egg capsule had been formed.

The egg capsules are normally attached to some hard and fixed surface, but when accidentally detached they float base downwards and their centre of gravity must be at such a point as to ensure this, for whatever way they are placed in the water they roll over into their normally vertical position.

The complete capsule, now thoroughly dried, has shrunk and the protoconchs have probably disintegrated as they cannot be seen within the cavities. In all probability the capsule had only just been completed and little development of the embryonic shell had taken place.

There are apparently about ten sections, or individual cavities, situated at the circumference of each of the ten layers, giving a possible one hundred cavities and protoconchs, though a number of the apical cavities may not contain embryos. Compared with the Western Australian specimen, which measured in length 165 mm. and width 75 mm., our specimen appears bigger. However the Western Australian specimen has evidently shrunk in the preservative. Again the number

of protoconchs found in the Western Australian specimen was forty-seven, but they were in a very advanced stage of development, on the point of hatching, and presumably about half of them had already left the capsule.

The Southern Australian Baler is found during summer and in certain definite areas, in groups of forty to fifty. The male is readily distinguished by its smaller size and slightly different shape. Fishermen frequently refer to the male and female as representing different species. We have records of living examples from Point Brown, Bell Sinclair and Smoky Bay (all on the West Coast of South Australia).

This constitutes the first authentic though brief observations on this interesting mollusc and since the time and place of breeding is now known further observations will probably be made.

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AUSTRALIAN CUMACEA. NO. 9[1]
THE FAMILY NANNASTACIDAE

By Herbert M. Hale, Director, South Australian Museum

Summary

The material now dealt with was taken in shallow water off eastern and southern Australia, between latitudes 27° and 41° S. Some of it was secured by officers of the South Australian Museum, the bulk of it, as previously acknowledged, by Mr. K. Sheard, Division of Fisheries of the Council for Scientific and Industrial Research, while thanks are due also to Mr. I. S. R. Munro (Assistant Research Officer of the Fisheries Division), who very kindly recently submitted a formalized Cumacean collection made by him in Moreton Bay (Brisbane), Queensland.

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Fig. 1–49.

INTRODUCTION.

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Scarcely anything is yet known of the Cumacea of the northern coast of Australia and little more of those from the western coast. Russell and Orr (1931, fig. 1) published a map showing that most of the oceanographic research in the Western Pacific, prior to the Great Barrier Reef Expedition, has been concentrated in the region of the Dutch East Indies and the Philippine Islands. Since then investigations have been carried out by the Department of Zoology, University of Sydney, and the C.S. and I.R. Division of Fisheries.

Family NANNASTACIDAE.

Picrocuma Hale, a genus with some unusual characters, is now referred to this family. Including the twenty-five species herein described as new, the thirty-four named members of the family occurring along the Australian coast are distributed among the genera as follows: *Nannastacus,* 10; *Schizotrema,* 1; *Cumella,* 7; *Picrocuma,* 1; *Campylaspis,* 14; *Procampylaspis,* 1.

As regards *Procampylaspis,* it is interesting to find south of the southern tropic a form which differs very little indeed from the boreal genotype (see remarks by Zimmer, 1913, p. 483 *et seq.*).

Genus Nannastacus Bate.

Nannastacus Bate, 1865, p. 86; Stebbing, 1913, p. 168 (syn. and key); Zimmer, 1921, pp. 133–134 (keys).

Zimmer keys the species which have the peduncle of the uropod less than twice as long as the telsonic somite. He omits *hirsutus* Hansen which he considers is a *Cumella,* and is of opinion that *sarsi* Kossmann is probably referable to *Schizotrema.* Only one species (*gurneyi* Calman) has been described as new since 1921. In 1936 I recorded material of the genus from South Australia as representing three of Calman's species. Since then further specimens have been collected and it is now considered that they should be regarded as distinct species and not variants (Hale 1937, p. 73). Zimmer mentions that specific differences

(1) For No. 8 see *Trans. Roy. Soc., S. Aust.,* lxiii, 1944, pp. 225–285, fig. 1–38.

within this genus are often slight. He uses the proportions of peduncle, rami and distal spines of the uropod largely in his key; these proportions vary very little indeed in the same sex of Australian species of which long series of adults are available. The number of spaced short spines on the inner margin of the endopod of the uropod of the species having the peduncle of that appendage short is also constant; these spines may be preceded by a short seta, much more slender than the stouter spines, and the margin also bears minute spinules.

In all Australian species where the adult male is available the exopodal recess in the basis of the peraeopods of this sex has a more or less developed comb-like outer edging: these flattened spines are absent in *mystacinus* Zimmer from New Britain (Zimmer, 1921, pp. 134 and 139).

Zimmer evidently does not consider necessary *Parananastacus* Stebbing (1912, p. 164) which was established to accommodate Calman's *Nannastacus reptans* and *tardus*, and it would seem that the suppression of an exopod here and there in the female is not of particular significance in this genus (Calman, 1911, p. 360). The females of the Australian species, where available, have well-developed exopods on the first and second peraeopods; in *inflatus*, *subinflatus* and *johnstoni* spp. nov. there is no exopod on the third maxillipeds in this sex.

As in the case with *Cumella*, males greatly predominate, indeed are practically exclusively present, in collections secured on the bottom by submarine light (Sheard, 1941, p. 12) and in surface material taken by tow-net. Females of littoral species which are found on reefs have been secured by using the formalin method (Hale, 1936, p. 404).

Altogether seven species are now named as new; both sexes are available in four of these, the male only of the others being described. Unless, as in the case of these males, the body armature is distinctive, the practice of authors has been to avoid naming members of the genus from this sex alone.

Th most northerly records of the genus on Australian coasts are, on the west *nasutus* Zimmer (lat. 27° S.), and on the east *suhmii* Sars (lat. 16° 23′ S., Foxon, 1932, p. 392).

Zimmer's keys are here modified to include all species at present named.

KEY TO MALES OF SPECIES OF *NANNASTACUS*.

The female also is known in the species marked (*).

1. Uropod with peduncle at least twice as long as telsonic somite .. .. .. 2.
   Uropod with peduncle less than twice as long as telsonic somite .. .. .. 5.
2. Pseudorostrum long, the lobes meeting for a distance equal to at least one-sixth of length of carapace .. .. 3.
   Pseudorostrum with lobes meeting for a much shorter distance .. *lepturus* Calman.
3. Propodus of first peraeopod less than twice as long as dactylus *longirostris* Sars.
   Propodus of first peraeopod about three times as long as dactylus .. .. 4.
4. Peduncle of uropod less than twice as long as endopod .. *brachydactylus* Calman.
   Peduncle of uropod at least twice as long as endopod .. *nasutus* Zimmer.*
5. Dorsum of pleon with conspicuous paired spines (or elongate tubercles) on at least first five somites .. .. 6.
   Dorsum of pleon with conspicuous spines or tubercles on at most first two somites .. 14
6. First four pleon somites each with a pair of subcylindrical dorsal processes, which with their apical spines are higher than vertical depth of the somites .. *hanseni* Calman.
   Pleon somites with at most low dorsal processes, which together with their apical spines are never as high as vertical depth of somites .. .. 7.
7. Dorsum of fourth and fifth peraeon somites strongly raised medianly .. .. 8.
   Dorsum of fourth and fifth peraeon somites not raised medianly .. .. 9.

8. Dorsum of each pleon somite with a pair of serrate dorsal carinae, the teeth acute *ossiana* Stebbing.
Dorsum of each pleon somite with two rows of blunt-ended large tubercles *inconstans* sp. nov.

9. Peduncle of uropod fully as long as telsonic somite and barely shorter than endopod. Large dorsal spines (or tubercles) of anterior pleon somites clavate .. *clavatus* sp. nov.
Peduncle of uropod much shorter than either telsonic somite or uropod. Large dorsal spines of anterior pleon somites acute or subacute .. .. 10.

10. Endopod of uropod not more than twice as long as peduncle .. *brevicaudatus* Calman.*
Endopod of uropod more than twice as long as peduncle 11

11. Antero-lateral angles of carapace serrate .. .. 12.
Antero-lateral angles of carapace not serrate .. .. 13.

12. Pseudorostral lobes meeting below. Exopod of uropod about one-third as long as endopod *unguiculatus* (Bate).*
Pseudorostral lobes gaping below. Exopod of uropod very short, about one-tenth as long as endopod .. .. *asper* sp. nov.

13. Back and sides of carapace spinose .. .. .. *sarsi* Kossmann.
Back and sides of carapace not spinose .. .. .. *stebbingi* Calman.

14. Peduncle of uropod distinctly longer than telsonic somite .. *sheardi* sp. nov.
Peduncle of uropod shorter than telsonic somite .. .. 15.

15. Including the terminal spine in the length of each ramus, the exopod of the uropod is barely more than one-fourth as long as endopod .. .. *submiti* Sars.*
Measured thus, the exopod of uropod is at least more than one-third as long as endopod 16.

16. Terminal spine of exopod of uropod reaching to distal end of endopod (without its spine) *pardus* Calman.
Terminal spine of exopod of uropod not reaching to distal end of endopod .. .. 17.

17. First pleon somite with a distinct median, longitudinal, dorsal pit *georgi* Stebbing.
First pleon somite with no pronounced dorsal pit .. .. 18.

18. Terminal spine of exopod of uropod not reaching beyond middle of length of endopod (not including terminal spine of latter) .. .. 19.
Terminal spine of exopod of uropod reaching beyond middle of length of endopod (not including terminal spine of latter) .. .. 20.

19. Antero-lateral corner of carapace rounded. Last pedigerous and first pleon somite with no dorsal tumidities .. .. *sauteri* Zimmer.*
Antero-lateral corner of carapace with spine. Last pedigerous and first pleon somite each with a dorsal tumidity .. .. *inflatus* sp. nov.*

20. Basis of anterior peraeopods with the usual external lamellate spines .. .. 21.
Basis of anterior peraeopods without external lamellate spines .. *mystacinus* Zimmer.*

21. Carpus of fifth peraeopod shorter, or barely longer, than propodus .. .. 22.
Carpus of fifth peraeopod half as long again as propodus .. *zimmeri* Calman.

22. Integument granulate. Last pedigerous and first two pleon somites each with a pair of dorsal spines. Inner margin of endopod of uropod with five short spines *subinflatus* sp. nov.*
Integument smooth. No dorsal spines on pedigerous or pleon somites. Inner margin of endopod of uropod with six spines .. .. .. *johnstoni* sp. nov.*

KEY TO FEMALES OF SPECIES OF *NANNASTACUS*.

The male also is known in the species marked (*).

1. Uropod with peduncle at least twice as long as telsonic somite .. .. .. 2.
Uropod with peduncle much less than twice as long as telsonic somite .. .. 3.

2. Pseudorostral lobes meeting above for greater part of length, but divergent near anterior ends. Propodus of first peraeopod less than twice as long as dactylus *longirostris* Sars.*
Pseudorostral lobes not gaping above near apex of pseudorostrum. Propodus of first peraeopod more than twice as long as dactylus .. .. *nasutus* Zimmer.*

3. Carapace with an open row of curved, laminate spines flanking the branchial regions *unguiculatus* Sars.*
Carapace without these spines .. .. 4.

4. Carapace with short, stout, thorn-like spines on back and sides *erinaceus* Zimmer.
Carapace without such spines .. 5.

5\. Uropod unusually short, its endopod not longer than telsonic somite and with distal spine stout and claw-like .. .. *brevicaudatus* Calman.†
Endopod of uropod longer than telsonic somite and with distal spine more slender 6.

6\. First two pleon somites with strong, paired, dorso-lateral teeth .. .. 7.
First two pleon somites smooth dorsally, or with insignificant teeth .. .. 8.

7\. Including distal spine in the length of each ramus, the exopod of the uropod is only about one-third length of endopod .. .. *sohmii* Sars.*
Measured thus the exopod of uropod is more than half the length of endopod *subinflatus* sp. nov.*

8\. Pleural parts of free pedigerous somites with marginal laminar spines .. .. 9.
Pleural parts of free pedigerous somites without marginal laminar spines .. .. 10.

9\. First and second peraeopods with exopod .. .. *agnatus* Calman.
First and second peraeopods with no exopod .. .. .. *tardus* Calman.

10\. Peduncle of uropod longer than telsonic somite .. .. 11.
Peduncle of uropod shorter than telsonic somite .. .. 13.

11\. Eyes placed close together .. .. *hirsutus* Hansen.
Eyes separated by a wide interspace .. .. 12.

12\. Branchial siphons unusually long, more than half as long as carapace. Carapace with long scattered hairs. Peduncle of uropod half as long again as telsonic somite *gurneyi* Calman.
Branchial siphons short, only about as long as pseudorostrum. Carapace granulate. Peduncle of uropod only one-third as long again as telsonic somite .. *sheardi* sp. nov.*

13\. Endopod of uropod (not including distal spine) barely more than twice as long as peduncle, or shorter .. .. 14.
Endopod of uropod (not including distal spine) at least two and one-half times as long as peduncle .. .. 17.

14\. First and second peraeopods without exopods .. .. *reptans* Calman.
First and second peraeopods with exopods .. .. 15.

15\. Eyes placed close together. Peduncle of uropod not much shorter than endopod without its distal spine .. .. *lima* (Hale).
Eyes well separated. Peduncle of uropod only half as long as endopod without its distal spine .. .. 16.

16\. Carapace with a median dorsal depression between branchial regions. Terminal spine of exopod of uropod reaching nearly to distal end of endopod .. .. *minor* Calman.
Carapace with dorsum not sulcate between branchial regions. Terminal spine of exopod of uropod reaching barely beyond three-fourths of length of endopod *johnstoni* sp. nov.†

17\. Endopod of uropod with two to three short spines on inner margin .. .. 18.
Endopod of uropod with four to five short spines on inner margin .. .. 20.

18\. Terminal spine of endopod of uropod slender, more than half as long as the ramus *sauteri* Zimmer.†
Terminal spine stouter, less than half as long as the ramus .. .. .. 19.

19\. Branchial regions greatly inflated. Carpus of fifth peraeopod shorter than propodus *inflatus* sp. nov.*
Branchial regions not strikingly inflated. Carpus of fifth peraeopod nearly half as long again as propodus .. .. *zimmeri* Calman.*

20\. Terminal spine of exopod of uropod reaching nearly to distal end of endopod *mystacinus* Zimmer.
Terminal spine of exopod of uropod reaching to only four-fifths of length of endopod *gibbosus* Calman.

NANNASTACUS NASUTUS Zimmer.

Nannastacus nasutus Zimmer, 1914, p. 184, fig. 11–12.

Zimmer described the female from Western Australia. A species common in Moreton Bay, Queensland (I. S. R. Munro, various stations) seems to be referable here, although the size is smaller, an ovigerous female being only 1·65 mm. in length while the numerous males are about 1·8 mm.

In these males the pseudorostral lobes meet for a distance equal to somewhat less than one-fourth of the length of the carapace. The propodus of the first peraeopod is subequal in length to the carpus and is less than three times as long as dactylus, one of the terminal setae of which is very stout and is fully as long as its

joint The propodus and dactylus of the second peraeopod do not differ much in length.

The carpus of the fifth peraeopod is less than half as long again as propodus.

The peduncle of the uropod is twice as long as the endopod or a little longer; the endopod bears about seven spines on the inner margin and its terminal spine is fully half as long as the ramus.

As in the male of *brachydactylus* Calman (1905, p. 14, fig. 3—female unknown) from seas north of Australia the eyes are placed close together; *nasutus* apparently differs in no important feature from Calman's species excepting that the peduncle of the uropod is relatively a little longer, and the endopod of that appendage carries a long instead of a very short spine.

NANNASTACUS NASUTUS var. CAMELUS Zimmer.

Nannastacus nasutus var. *camelus* Zimmer, 1914, p. 186, fig. 13; Hale, 1937, p. 73, fig. 9.

This variety was previously recorded from the female only. Males, from a number of South Australian localities, have the dorsal convexity posterior to the eyes not so prominent as in the female and, even so, varying somewhat in degree of development.

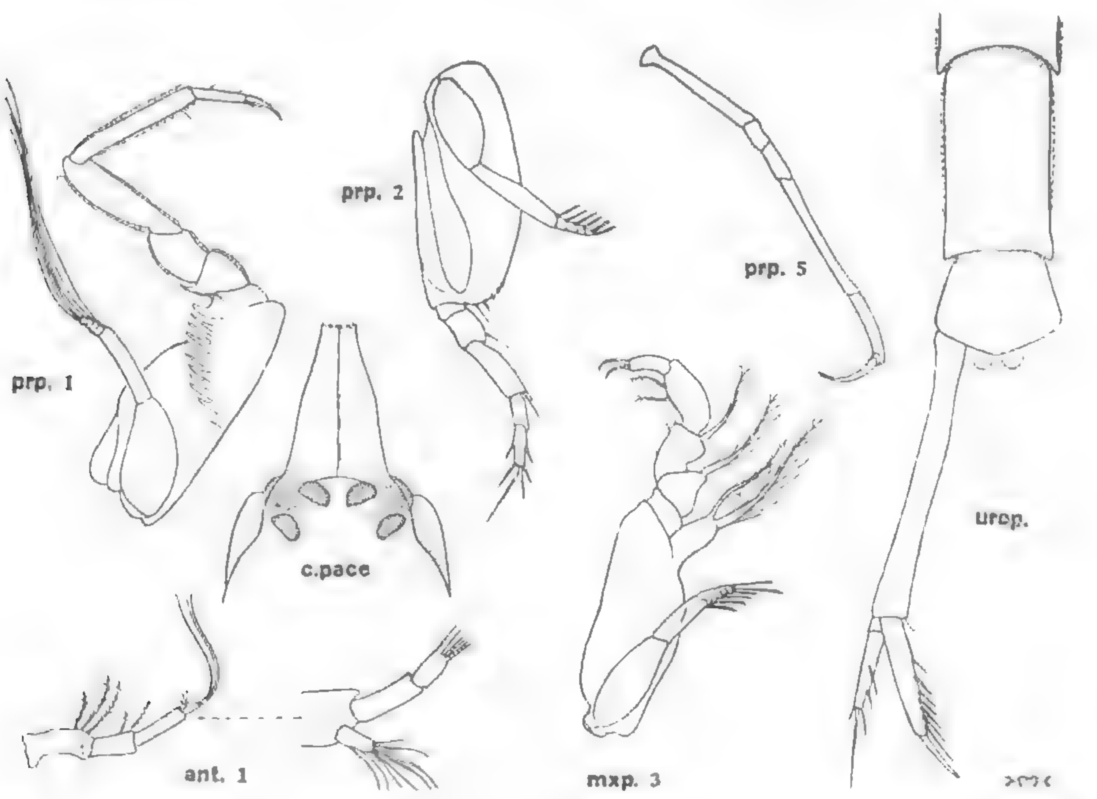

Fig. 1. *Nannastacus nasutus* var. *camelus*, adult male; c. pace, ocular lobe and pseudorostrum (× 64); ant. 1, first antenna (× 74; flagella, × 270); mxp. and prp., third maxilliped and peraeopods (× 74); urop., uropod with fifth pleon and telsonic somites (× 74).

Adult male. Pseudorostral lobes meeting for a distance equal to about one-fourth of total length of carapace, and with their anterior ends coarsely serrate; they meet for their whole length and do not diverge near apices; eyes each with three corneal lenses, the innermost separated from its opposite fellow by only about one-half the diameter of a lens; a low but distinct median carina runs from pseudorostrum to posterior margin of carapace.

First antenna with third joint of peduncle barely longer than second, and not much shorter than first; accessory flagellum single-jointed, relatively large, one-half the length of the first segment of the two-jointed main lash.

Basis of first peraeopod with usual lamellate comb; not much more than two-thirds as long as rest of limb; ischium with a flattened spine at distal end of outer margin; carpus equal in length to propodus, which is two and one-half times as long as dactylus; the latter has a distal claw (as well as one or two slender setae) shorter than the joint.

Second peraeopod with basis distinctly longer than rest of limb; ischium distinct; merus much shorter than carpus and as long as dactylus, which is not much longer than propodus, longest dactylar seta about as long as dactylus and propodus together.

Carpus of fifth peraeopod more than three times as long as merus and almost twice as long as propodus, which is somewhat longer than dactylus.

Telsonic somite dilated posteriorly, where it is broader than long; fifth pleon somite narrow, twice as long as wide.

Uropod with peduncle smooth, two and three-fourths times as long as telsonic somite and distinctly more than twice as long as endopod; exopod three-fourths as long as endopod with terminal spine slender and reaching to tip of distal spine of endopod; on inner margin of endopod are three setae (one really distal) and at outer side of terminal bristle is a short seta; endopod with terminal spine stout, less than half as long as the ramus, and with seven very slender spines, successively increasing in length, on inner margin.

Colour milk white, without any dark pigmentation excepting on ocular lobe.

Length 2·5 mm.

While the Queensland examples of *nasutus* are smaller than the types, the South Australian specimens of the variety are larger; *nasutus camelus* has been taken only on the south coast, between long. 117° and 138°, about lat. 35° S, *nasutus* only above lat. 28° S., on both east and west coasts.

NANNASTACUS INCONSTANS sp. nov.

Adult male (cristate form). Carapace two-fifths of total length of animal, wider than greatest depth, which is more than half its length; its anterior portion and the moderately inflated branchial regions are studded with large granules, but near the inferior margin the surface is squamose-reticulate; dorsally there is a double row of tubercles, small anteriorly and posteriorly but for approximately the middle third of length of carapace high, flattened, distally dilated and crowded, producing the appearance of a pair of longitudinal crests; lateral to each row of large tubercles is a curved series of small tubercles; at hinder end of carapace is a median tumidity, granulate (as well as with the aforementioned rows of tiny tubercles) and feebly bilobed at the rear; behind each eye is a prominent tuberculate elevation, posterior to which and a little above its level, is a small rounded boss. Eyes widely separated, each with the usual three corneal lenses. Antero-lateral angle with small spiniform tubercles, none of which very definitely emphasizes the angle. Pseudorostral lobes widely gaping above but meeting below.

Pedigerous somites together barely more than half as long as carapace, the third and fourth unusually wide, as broad as the second and as the carapace; first exposed only as narrow strip; dorsally the first and second somites are short, but the back of the third to fifth is elevated and (like the pleural portions of second to fifth) strongly tuberculate; the tubercles on the pleurae of the fifth somite are elongate, almost spiniform.

Pleon about three-fourths as long as cephalothorax, granulate, the dorsum of each somite with two longitudinal rows of three or four larger tubercles, the last

of which is more prominent than the others; fifth somite little longer than fourth and not much longer than wide; telsonic somite a little longer than wide, posteriorly rather well produced above bases of uropods.

First peraeopod with basis two-thirds as long as remaining joints together; carpus only about one-tenth as long again as propodus and twice as long as dactylus, the longest distal seta of which is rather stout.

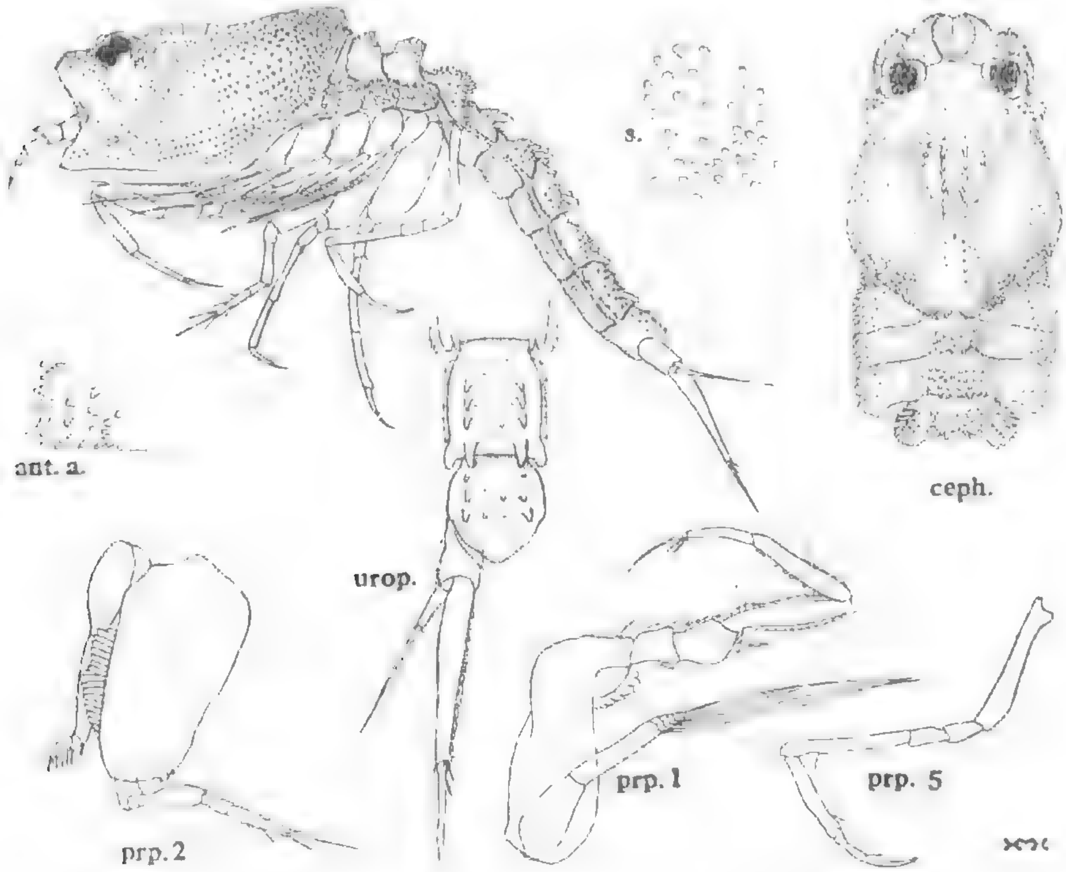

Fig. 2. *Nannastacus inconstans*, adult male, cristate form; lateral view and (ceph.) cephalothorax from above (× 59); s. and ant. a., sculpture of carapace over branchial region, and antero-lateral angle (× 185); prp., peraeopods (× 95); urop., uropod with fifth pleon and telsonic somites (× 95).

Second peraeopod with basis barely longer than rest of limb; ischium not distinctly made out; carpus twice as long as merus, which is barely longer than the elongate dactylus; the last-named is twice as long as propodus with its longest distal spine longer than the joint itself.

Posterior peraeopods long and slender; fifth pair fully as long as pleon with carpus about one-fourth as long again as propodus and more than three times as long as merus.

Peduncle of uropod less than two-thirds as long as telsonic somite and little more than one-third as long as endopod exclusive of its distal spine; exopod nearly one-third as long as endopod and with its terminal spine reaching to distal end of latter; endopod with two unequal spines at inner side of distal spine (which is more than half the length of the ramus) and with inner margin serrate for whole length but without articulated spines.

Length 1·35 mm.

Colour pale brown, the carapace margined with white in front and below.

Loc. South Australia: Backstairs Passage, Page Islands, 9 fath. (K. Sheard, submarine light, Apl., 1941). Types in South Australian Museum, Reg. No. C. 2614 and 2616.

Adult male (reticulate form). A male taken with that recorded above has so many features in common with it that there can be little doubt that it represents a different form of this sex in the same species. The pedigerous somites, pleon and the appendages are as described, excepting that the dorsal tubercles are somewhat more prominent and the endopod of the uropod is relatively a trifle shorter, although it is otherwise exactly similar, with the three unequal distal spines, serrated inner edge, etc. The sculpture of the carapace, however, is very different.

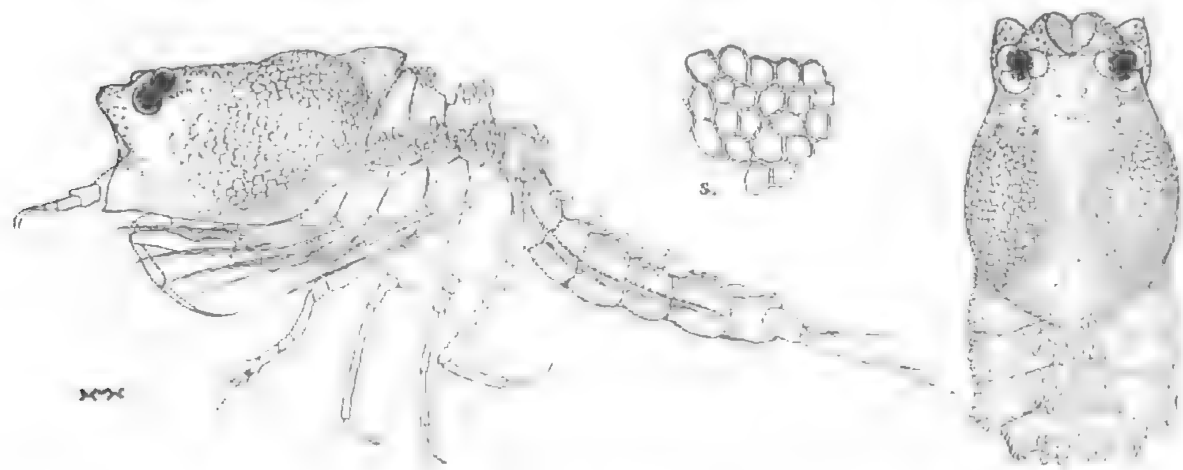

Fig. 3. *Nannastacus inconstans*, adult male, reticulate form; lateral view and cephalothorax from above (× 59); s., sculpture of integument over branchial region (× 185).

The branchial regions are more inflated and the surface of the integument here is marked with a distinct reticulate patterning (at S., fig. 2 and 3, the sculpture of the two varieties is to the same scale). There are no crests of tubercles on the dorsum, which bears scattered granules, vaguely arranged in longitudinal series behind the eyes, and there are no tumidities posterior to the eyes.

Length 1·35 mm.

This species is distinguished by the wide pedigerous somites and the armature of the pleon, plus the long posterior peraeopods and the character of the uropods.

NANNASTACUS CLAVATUS sp. nov.

Adult male. Integument of back and sides studded with large, distally dilated granules; a characteristic armature of dorsal tubercles on second to fifth pedigerous and first to fifth pleon somites; very sparse hairs.

Carapace distinctly more than one-third of total length of animal; it is less than twice as long as deep and not depressed, the width being equal to depth; seen from above it is suboval in shape, widest at about middle of length; dorsum as seen from the side almost evenly curved, except for a slight angularity in front of eyes. Antero-lateral margin shallowly concave; antero-lateral angle rounded and armed below with a single small tooth. Pseudorostral lobes meeting above and below for whole length; anteriorly they are subtruncate as seen from above, rounded and with a few teeth in lateral view.

First pedigerous somite shorter than second and partly concealed; second to fourth somites with pleural parts broadly expanded, granulate; on the back the second and third each bear a pair of curved, distally dilated, large tubercles, the

fourth has four such tubercles in a transverse row and the fifth a pair, closely followed by a row of four nearer its hinder margin.

First pleon somite with six large dorsal tubercles arranged as on last pedigerous; second and third somites each with two dorso-lateral tubercles on each side;

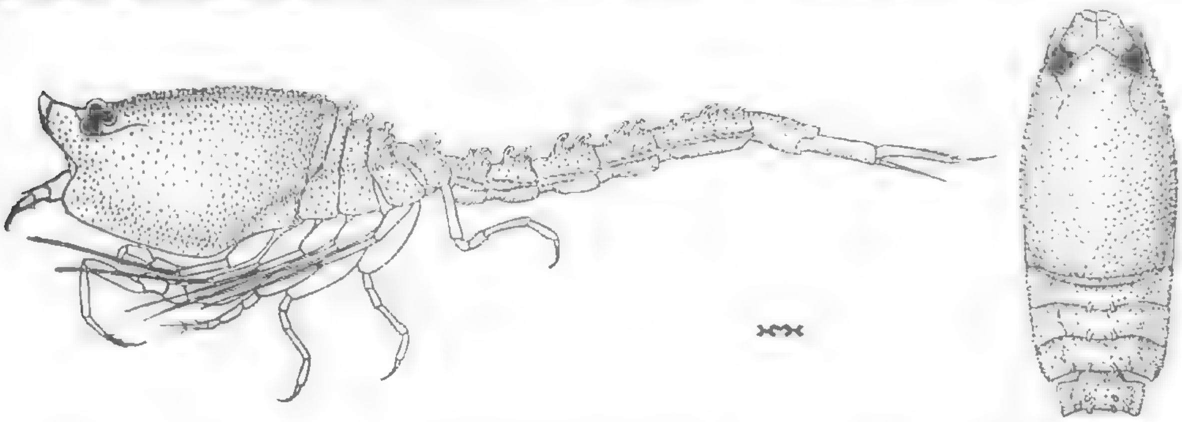

Fig. 4. *Nannastacus clavatus*, lateral view and dorsal view of cephalothorax of type male (× 44).

placed one behind the other, and scarcely dilated distally; fourth and fifth with three dorso-lateral tubercles on each side, the first smaller than the others on both somites; these are more like blunt spines and on the fifth somite the granules are themselves spine-like towards the rear; telsonic somite as long as wide, rounded posteriorly and with small acute projections, its dorsum with irregular granules but no large tubercles; fifth somite distinctly longer than the others, less than half as long again as broad.

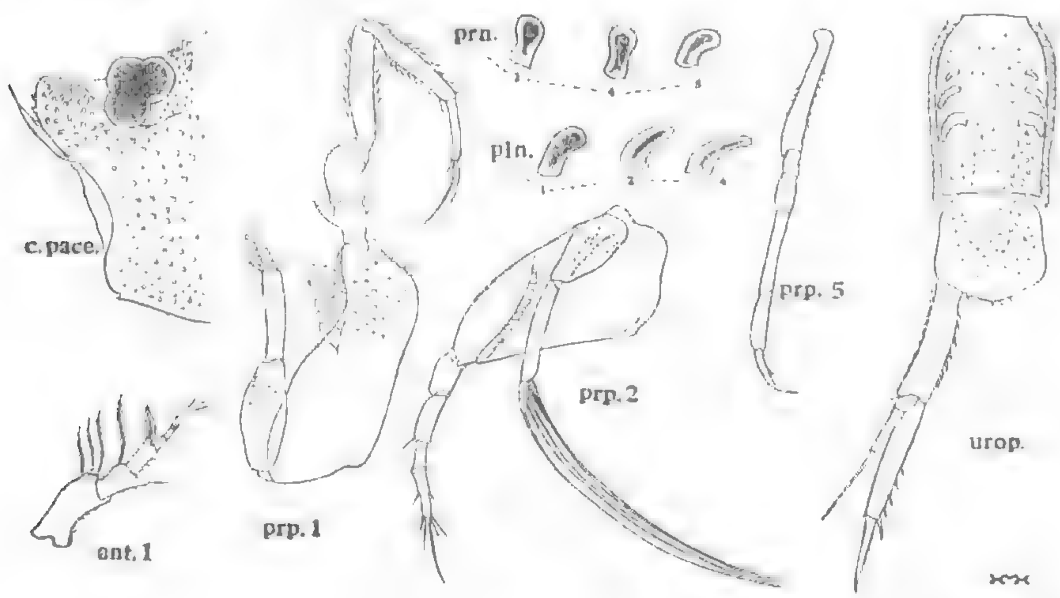

Fig. 5. *Nannastacus clavatus*, paratype male; c. pace, anterior portion of carapace (× 86); prn. and pln., large tubercles from back of pedigerous and pleon somites; ant. and prp., first antenna and peracopods (× 86); urop., uropod with fifth pleon and tensonic somites (× 86).

At prn. and pln. in fig. 5, tubercles from pedigerous somites 2, 4 and 5, and pleon somites 1, 2 and 4 show the gradual change from dilated to spiniform projections.

First joint of peduncle of first antenna twice as long as third which is shorter than second.

Propodus of third maxilliped distinctly longer than carpus and nearly twice as long as dactylus.

First peraeopod with basis less than two-thirds as long as rest of limb; propodus shorter than carpus, and almost twice as long as dactylus; the ischium has a strong spine on outer margin.

Second peraeopod two-thirds as long as first; basis less than half as long again as rest of limb; ischium indistinctly marked off; carpus only as long as dactylus, which is less than twice as long as propodus.

Carpus of fifth peraeopod nearly half as long again as propodus.

Peduncle of uropod a little longer than telsonic somite and not much shorter than endopod exclusive of its terminal spine; it is serrate on both edges; exopod slightly more than half as long as endopod and with its terminal spine reaching beyond distal end of latter; endopod with five spines on inner margin (including sub-distal one), which successively increase in length backwards, and with distal spine stout, distinctly more than half as long as its ramus and almost as long as the more slender spine of the exopod.

Colour yellowish-white.

Length 1·9 mm.

Loc. South Australia: Backstairs Passage, Page Islands, 9 fath. (K. Sheard, submarine light, Apl., 1941). Type male in South Australian Museum, Reg. No. C. 2604.

The situation in which this species was taken is rough, the islands being almost incessantly pounded by heavy seas, rendering collecting difficult excepting under unusually favourable circumstances.

NANNASTACUS ASPER sp. nov.

Nannastacus hanseni Hale (*nec* Calman), 1936, p. 431.

Adult male. Integument of back and sides with spiniform tubercles, becoming sparser on telsonic somite.

Carapace barely more than one-third of total length of animal, depressed, a little less than twice as long as deep, and twice as long as the pedigerous somites together; antero-lateral and branchial regions swollen and a posterior median tumidity; spiny armature conspicuous and close-set but no outstanding larger spines. Antero-lateral margin deeply and rather angularly concave; antero-lateral angle produced to form an acute spine, and lower border of carapace posterior to it margined with spinules. Pseudorostral lobes subtriangular, separated both above and below, distally acute when viewed from above and from the side rounded.

First pedigerous somite not visible behind carapace; second and third somites each with a pair of prominent spines on back; fourth with no large dorsal spines and fifth with a pair of low, stout elevations, each capped with a large and some smaller spines; pleural parts expanded and backwardly produced, spinose like sides.

First three pleon somites with paired dorsal elevations and spines as on last pedigerous somite; back of fourth less raised but with one pair of spines more prominent than the others; fifth distinctly longer than any of the others and about half as long again as wide, with no elevations on back but with one pair of spines at hinder end somewhat longer than the others; telsonic somite fully as wide as long, broadest behind middle of length, produced posteriorly and angularly rounded.

Third joint of peduncle of first antenna subequal in length to second and half as long as first.

Propodus of third maxilliped longer than carpus.

Basis of first three pairs of peraeopods with comb of lamellate spines.

First peraeopod with basis more than two-thirds as long as rest of limb; propodus subequal in length to carpus (not longer than it) and distinctly less than twice as long as dactylus.

Second peraeopod two-thirds as long as first; basis half as long again as rest of limb; carpus half as long again as merus and a little longer than propodus and dactylus together.

Carpus of fifth peraeopod less than one and one-fourth times propodus.

Peduncle of uropod about five-sixths as long as telsonic somite and much more than one-third as long as endopod exclusive of its terminal spine; exopod less than one-tenth as long as endopod and with its terminal spine not reaching to middle of length of latter; endopod with six short spines on inner margin and with distal spine only one-fourth as long as its ramus.

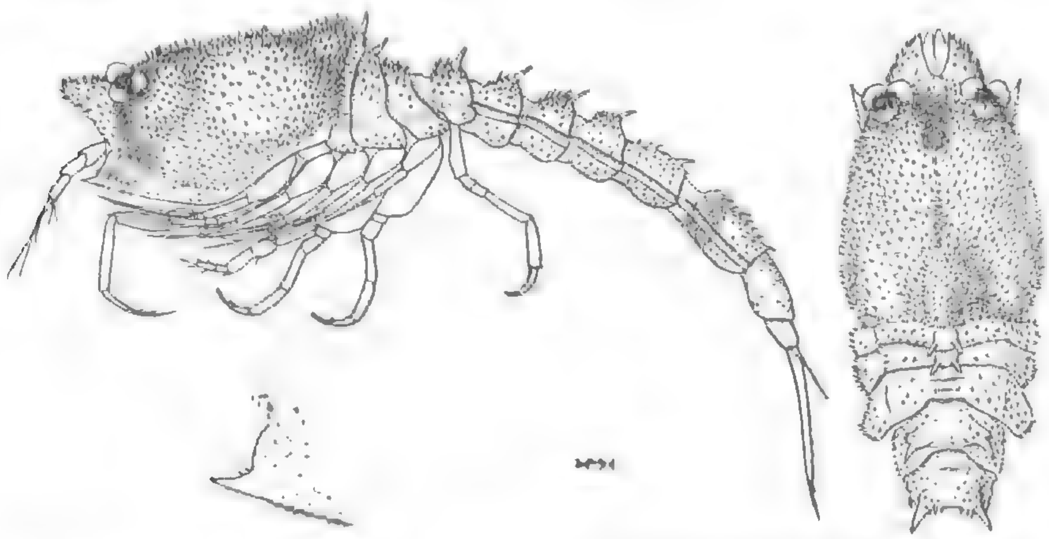

Fig. 6. *Nannastacus asper*, type male; lateral view and cephalothorax from above (× 37); antero-lateral angle of carapace (× 72).

Colour, yellowish white, with a dark marking between eyes and a conspicuous blackish band across anterior part of sides of carapace, but not including pseudorostrum and not extending quite to antero-lateral margin, leaving a whitish edging. Fifth pleon somite with a dark band on anterior half.

Length 2·3 mm.

Loc. South Australia: St. Vincent Gulf, Sellick's Reef, etc.; Spencer Gulf, Western Shoal (K. Sheard, tow-net, Feb., 1938), and Memory Cove, 3 fath. (type loc., K. Sheard, submarine light, Feb., 1941), etc. Tasmania: Cape Barren Island (D. L. Serventy, tow-net, Nov., 1939). Type in South Australian Museum, Reg. No. C. 2573.

The dark colour markings are characteristic but in a few examples are rather faint and the blotch between the eyes is almost or quite absent. The spiny armature is a little more prominent in some examples than in others.

Two males of this species were previously referred to Calman's *hanseni* (1905, p. 11, fig. 1) with which they agree in having the pseudorostral lobes divergent both above and below, in having the back of the pleon prominently spiny, etc. After examination of many more males (no females have been taken as yet) the Southern Australian species is separated because *hanseni* differs from it in the following particulars (1) the carapace is covered with rounded, not spiniform, tubercles, its median hinder tumidity is bilobed, and its antero-lateral angle is not produced as

a spine; (2) the pleon has the dorsal elevations higher and more slender while the fifth somite (like that of the related *ossiana* Stebbing, 1900, p. 612, pl. lxiv A) is not noticeably longer than any of the others; (3) the uropods are shorter and the carpus of the fifth legs relatively longer.

N. erinaceus Zimmer (1913, p. 450, pl. iv, fig. 36-37), has the carapace prickly as in *asper* but the thorn-like armature is differently arranged, while a pair of spines between the eyes are prominent, and there is a spine on each eye; the uropods of Zimmer's single female, from South Africa, are damaged.

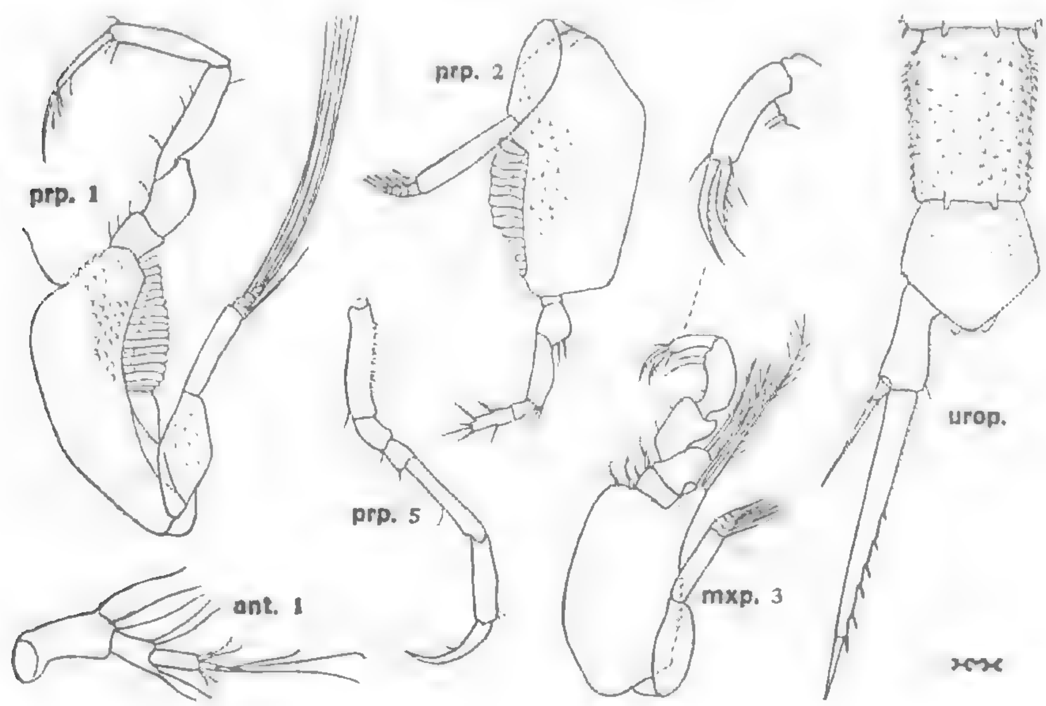

Fig. 7. *Nannastacus asper*, paratype male; ant., mxp. and prp., first antenna, third maxilliped and paraeopods (× 70; dactylus of maxilliped, × 156); urop., uropod with fifth pleon and telsonic somites (× 70).

NANNASTACUS SHEARDI sp. nov.

Cumella lima Hale (male only), 1936, p. 436, fig. 23, h and i.

Ovigerous female. Back and sides studded with small granules, none of which is enlarged or outstanding; a few scattered hairs are present.

Carapace one-third of total length; its greatest width, at the rear, is a little greater than its depth, and equal to three-fourths its length; there is a very fine but distinct median dorsal carina; seen from the side the dorsum is elevated at posterior end and the pseudorostrum is directed obliquely upwards. Antero-lateral margin not deeply concave; antero-lateral angle and margin behind it serrate (fig. 8, c, pace). Pseudorostral lobes meeting for whole length; both from above and from the side they are truncate and serrate in front.

First pedigerous somite fully exposed, with its pleural parts, like those of second and third somites, markedly expanded laterally, but not backwards; the fifth is somewhat tumid dorsally. Seen from above the whole cephalothorax is ovoid.

First and second pleon somites with dorsum slightly more tumid than in others; fifth somite much longer than any of the others, distinctly more than

twice as long as wide; telsonic somite dilated at distal end, rounded posteriorly but longer than width here.

Second and third joints of peduncle of first antenna equal in length, each less than half length of first.

Third maxilliped with exopod.

First peraeopod with propodus subequal in length to carpus and twice as long as dactylus.

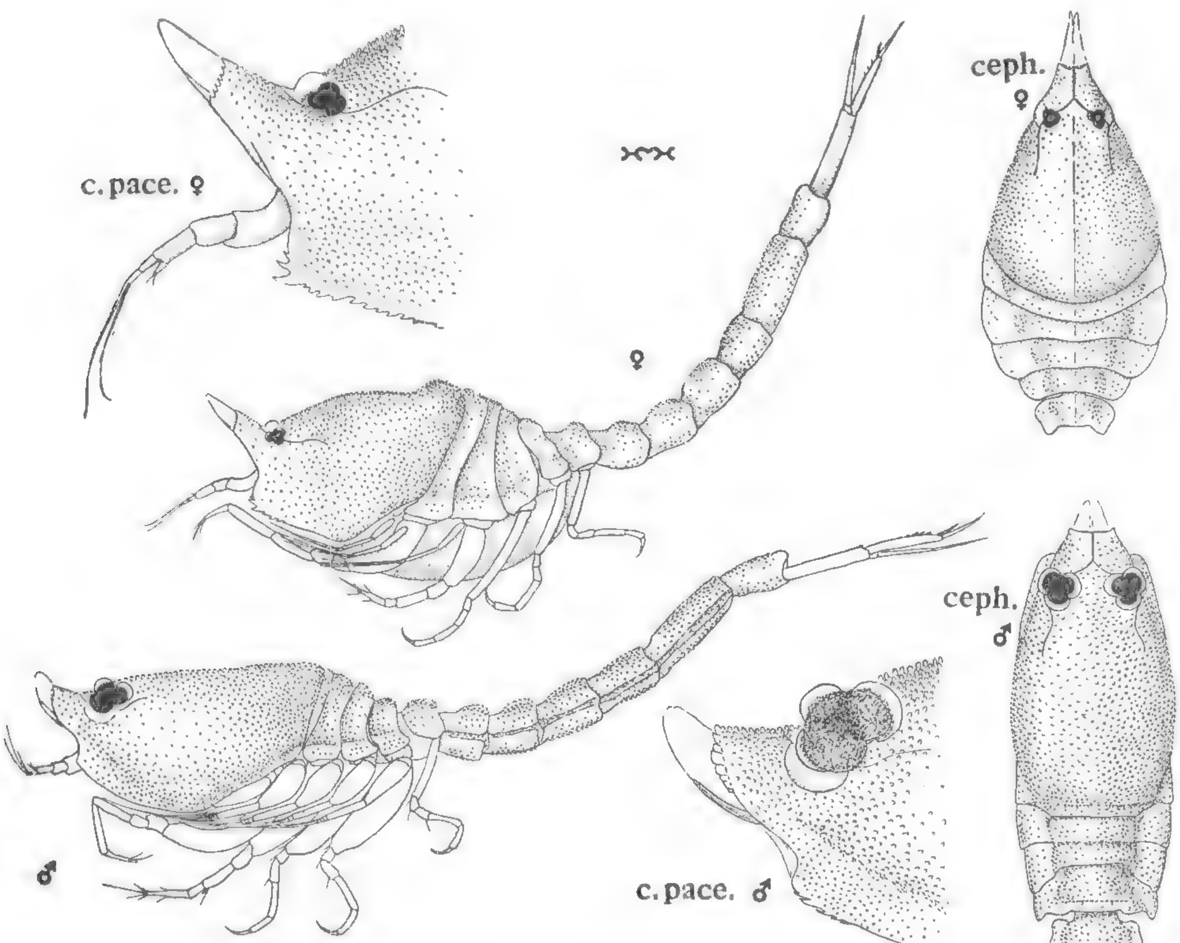

Fig. 8. *Nannastacus sheardi*, type female and paratype male; lateral view and (ceph.) cephalothorax from above (× 52); c. pace, anterior portion of carapace (× 115).

Second peraeopod two-thirds as long as first; basis four-fifths as long as rest of limb; ischium not distinctly marked off; carpus half as long again as merus but not as long as propodus and dactylus together; longest distal spine of dactylus longer than the joint.

Carpus of fifth peraeopod two-thirds as long again as propodus, which is equal in length to dactylus.

Peduncle of uropod one-third as long again as telsonic somite and nearly one-third as long again as endopod without terminal spine; exopod more than three-fourths as long as endopod, with its distal spine reaching not far short of the tip of the spine of the endopod; endopod with four spines on inner margin (the subdistal one much longer than the others) and with terminal spine more than two-thirds length of ramus and six-sevenths the length of exopodal spine.

Length 1·5 mm.

Colour, pale orange, with a dark irregular brown band across anterior part of carapace.

Adult male Granulation of integument a little more pronounced than in female.

Carapace more than one-third of total length, slightly depressed and twice as long as deep; from the side the dorsum is almost evenly rounded, scarcely elevated posteriorly, and the pseudorostrum does not form a decided angle as in the female. Antennal angle less prominent, the margin behind it serrate.

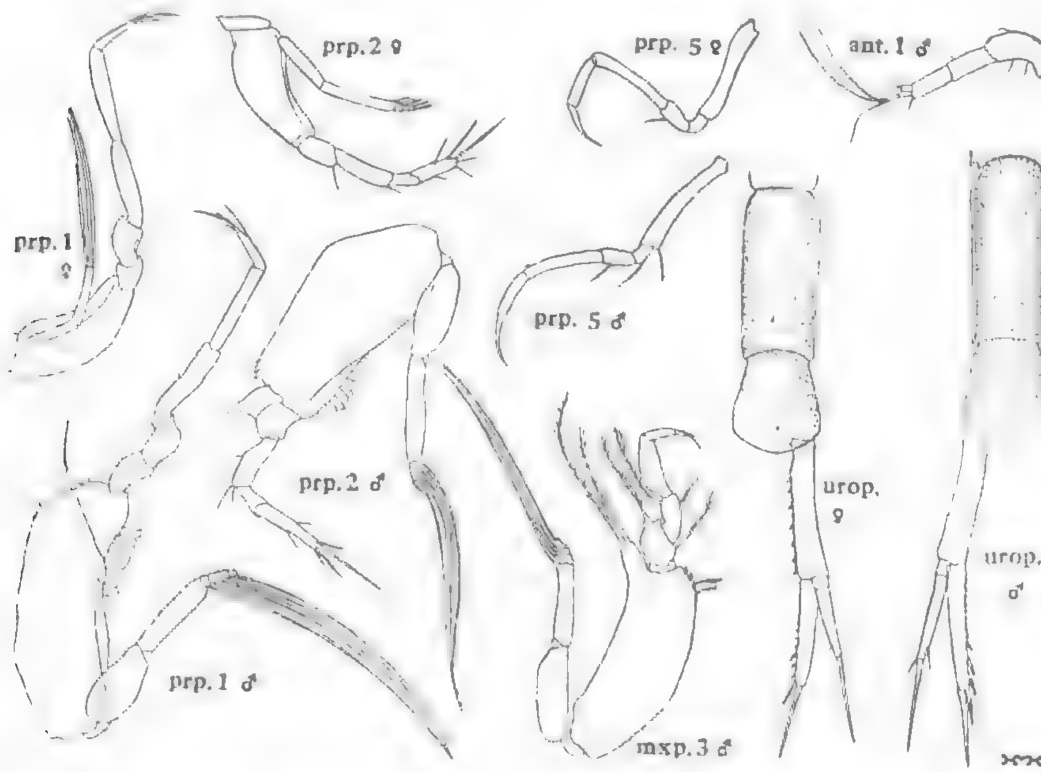

Fig. 9. *Nannastacus sheardi,* type female and paratype male; ant., mxp. and prp., first antenna, third maxilliped and peraeopods; urop., uropods with fifth pleon and telsonic somites (all × 86).

First pedigerous somite short, its pleural parts concealed. Fifth pleon and telsonic somites resembling those of female.

Peraeopods (apart from sexual differences) much as in female but the second is three-fourths as long as the first and has the dactylus longer, the carpus being shorter than it.

Peduncle of uropod more than one-third as long again as telsonic somite but only about one-sixth longer than endopod, the rami being a little longer than in female; exopod four-fifths as long as endopod without distal spine; endopod with four spines (preceded as in female by tiny spinules) on inner margin, the subterminal almost half as long as terminal, which is less than two-thirds the ramus and shorter than exopodal spine.

Length 1·59 mm.

Loc. South Australia: St. Vincent Gulf, Brighton, on shingle bar (type female, K. Sheard and B. C. Cotton, Mar., 1937); Wardang Island, 2 fath. (K. Sheard, submarine light, Feb., 1941); Sir Joseph Banks Group, on reef of gneiss rocks (B. C. Cotton, Dec., 1936). Types in South Australian Museum, Reg. No. C. 2607-2609.

When describing *lima*, the author recorded as that species a male which was associated with the females; the differences in the uropods were noted. Since then a small series of identical males was taken by submarine light, while also available is the female of *sheardi* recorded above, and other females from the Joseph Banks group; a comparison of the appendages (particularly the uropod) and fifth pleon and telsonic somites of the females with those of the males in question (cf. urop., fig. 9) leaves little doubt as to their relationship. (See also note under *lima* herein).

The females collected by Mr. Cotton have the granulation pronounced, the granules elongate.

V. gurneyi Calman (1927, p. 400, text fig. 101; female only, Gulf of Suez) is very like *sheardi* but is distinguished by the long rostral siphons, the different proportions of the uropods, etc.

NANNASTACUS INFLATUS sp. nov.

Nannastacus gibbosus Hale (*nec* Calman), 1936, p. 432.

Nannastacus zimmeri Hale (*part.*, *nec* Calman), 1936, p. 432.

Ovigerous female. Integument of back and sides with numerous small, glassy, distally dilated granules, closely beset on the carapace; with sparse hairy clothing.

Carapace more than one-third of total length; its greatest width is much greater than its depth and more than three-fourths its length; seen from above it is widest across the branchial regions which are much inflated, with a distinct median gutter between; there is a decided but smaller tumidity on each side anteriorly and a still smaller dorsal pair of low bosses behind the eyes; posteriorly there is a rounded median elevation, with its hinder end rather acute and backwardly produced; seen from the side these tumidities result in a very uneven dorsal outline and there is a decided angle at the base of the pseudorostrum. Antero-lateral margin deeply concave and antero-lateral angle bifid, being produced as an acute tooth, above which is a smaller tooth. Pseudorostral lobes gaping above and below; seen from the side they are subtruncate in front and coarsely serrate.

Pleural parts and a narrow strip of first pedigerous somite exposed; the dorsum of the second somite is somewhat elevated and capped with conspicuous tubercles; the fourth somite has a dorsal tumidity, divided by a longitudinal furrow and topped with large tubercles; the pleural parts are rounded and considerably expanded, the third somite being as wide as the carapace.

First pleon somite with dorsal prominence as on last pedigerous; fifth distinctly longer than any of the others, less than half as long again as wide, slightly swollen laterally just behind middle of length, and with a pair of conical dorsal tubercles at hinder margin, larger than the general surface tubercles; telsonic somite as wide as long, rounded posteriorly and broadest in distal half.

Third joint of peduncle of first antenna a little shorter than second and half as long as first.

Third maxilliped with no exopod; carpus and propodus equal in length.

First peraeopod with propodus a little longer than carpus and almost twice as long as dactylus.

Second peraeopod two-thirds as long as first; basis as long as rest of limb, carpus longer than ischium and merus together, and as long as propodus and dactylus together.

Carpus of fifth peraeopod shorter than propodus, which is barely longer than dactylus.

Peduncle of uropod fully three-fourths as long as telsonic somite and little more than one third as long as endopod, exclusive of its distal spine; exopod less

than one-tenth as long as endopod and with its terminal spine reaching just beyond three-fifths of length of latter; endopod with three short spines on inner margin and with terminal spine less than half the length of ramus.

Length 1·9 mm.

Adult male. Integument with granules not quite so prominent as in female.

Carapace a little more than one-third total length of animal, depressed, twice as long as deep and with tumidities as in adult female, although the branchial regions are never inflated to a like degree (cf. ceph., fig. 10). Antero-lateral angle

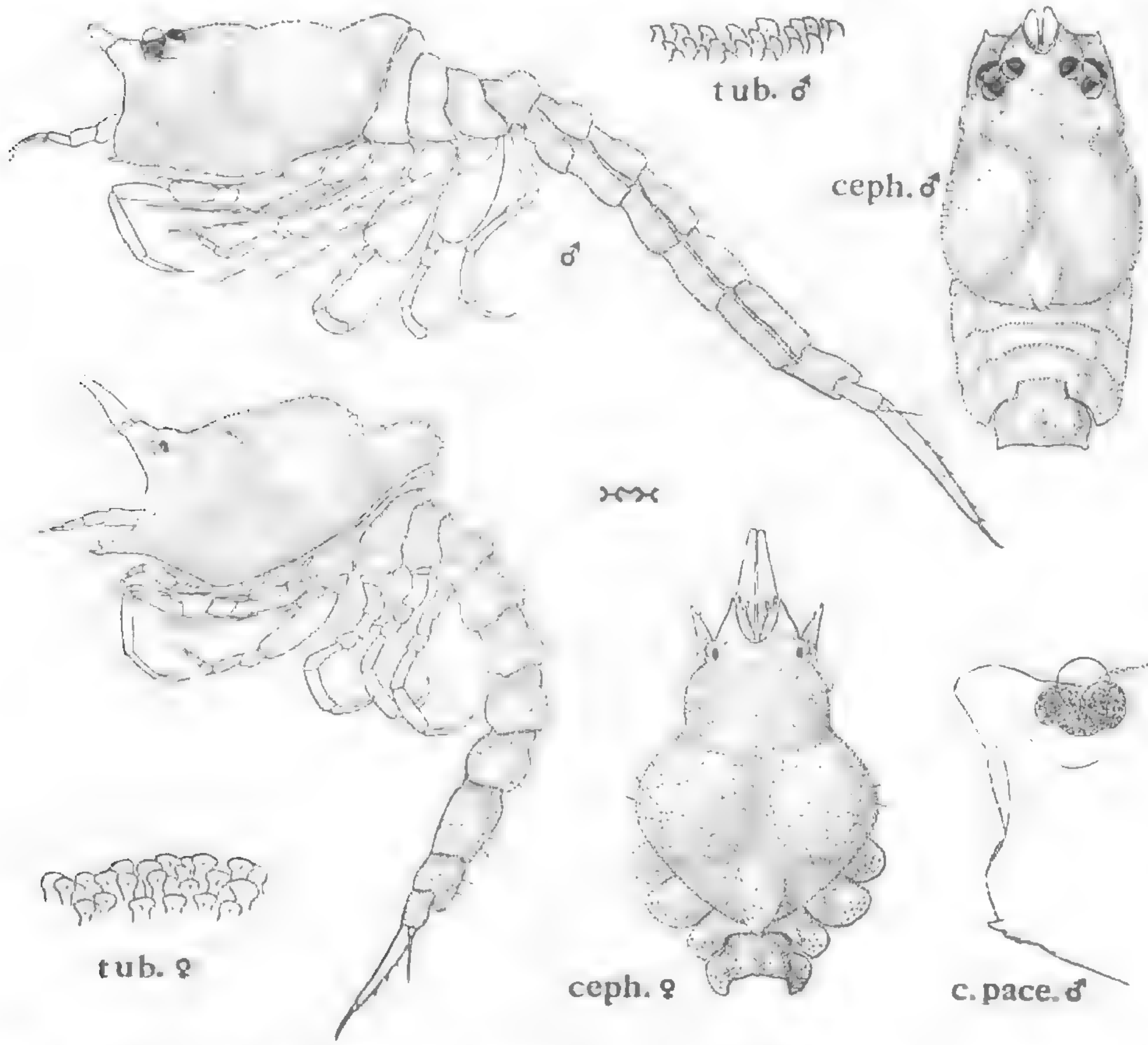

Fig. 10 *Nannastacus inflatus*, types adult male and ovigerous female; lateral views and (ceph.) cephalothorax from above (× 43); c. pace, anterior portion of carapace (× 86); tub., tubercles on back of carapace (× 240).

obtuse but actual corner produced as a spine, behind which the margin is serrate. Pseudorostral lobes not meeting above or below; oblique and crenulate in front as seen from the side. Eyes large and prominent, more so than in female.

First pedigerous somite exposed as narrow strip only. Dorsal elevations on last pedigerous and first pleon somites just as in female.

Basis of third maxilliped longer than rest of limb.

Basis of first peraeopod two-thirds as long as remaining joints, the proportions of which are as in female.

Carpus of fifth peraeopod about one-fourth as long again as propodus.

Peduncle of uropod about as long as telsonic somite and a little more than one-third as long as endopod exclusive of its distal spine; exopod one-fifteenth as long as endopod and with its terminal spine reaching just beyond two-fifths of length

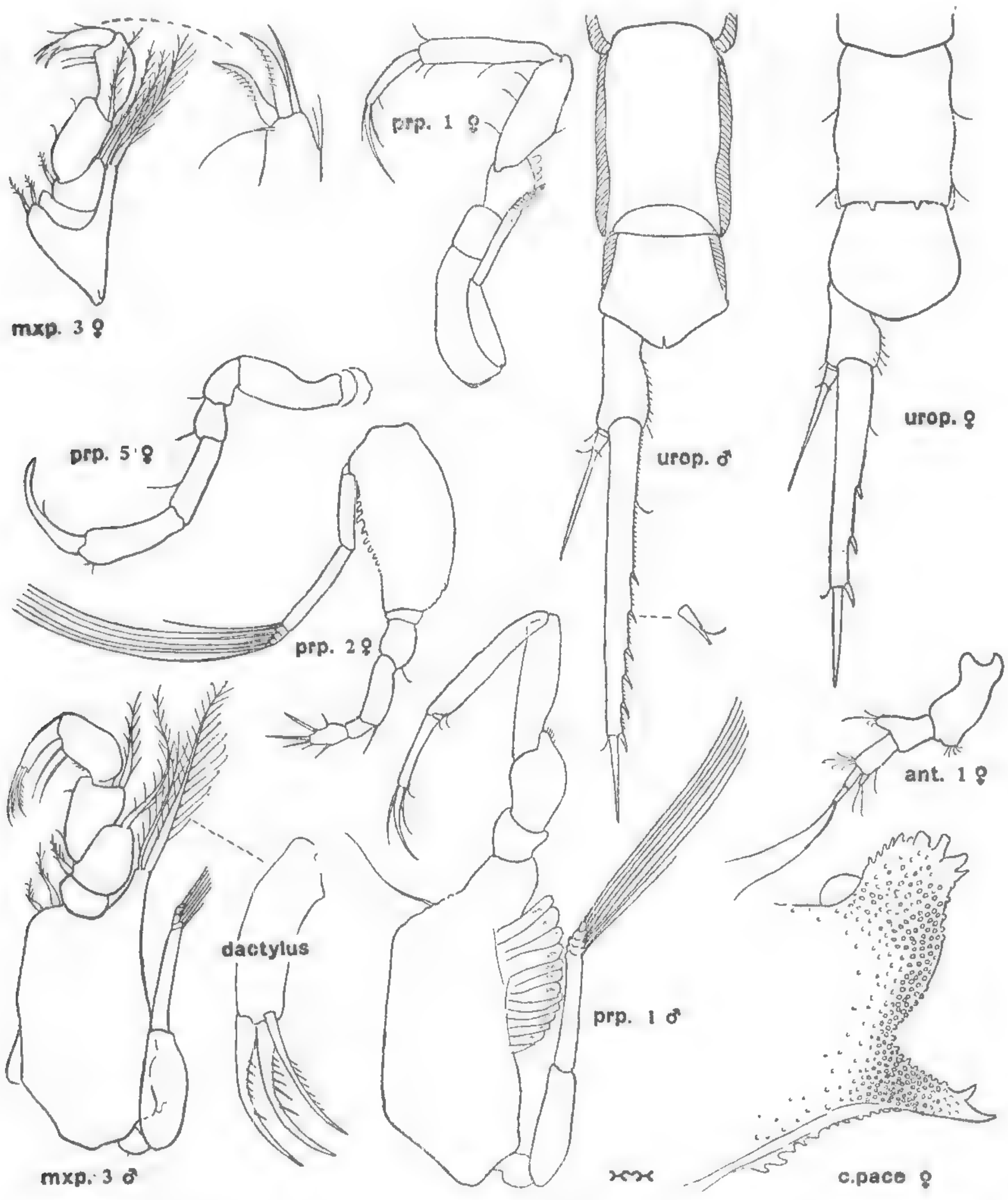

Fig. 11. *Nannastacus inflatus*, type male and paratype ovigerous female; c. pace, anterior portion of carapace, somewhat flattened; ant., mxp. and prp., first antenna, third maxillipeds and peraeopods; urop., uropods with fifth pleon and telsonic somites (× 164; dactyli of maxillipeds, × 270).

of latter; endopod with six short spines on inner margin and with terminal spine two-sevenths as long as its ramus.

Length 2·1 mm.

Colour (both sexes). Yellow shaded with pale brown, with scattered dark brown spots on carapace, and a few prominent blotches on legs. The most constant marking is a dark brown band, sometimes interrupted dorsally, on the fifth pleon somite.

Loc. South Australia: St. Vincent Gulf, Sellick's Reef, 1 fath., on stones (H. M. Hale, Jan. and Apl., 1936) and off Brighton jetty (Miss P. Mawson, Miss L. M. Angel and K. Sheard, submarine light, Oct., 1941) and Rapid Bay, 4 fath., on mud (H. M. Cooper and A. Rau, Jan., 1944); Pondalowie Bay (K. Sheard, tow-net, Mar., 1938); Kangaroo Island, Antechamber Bay (K. Sheard, submarine light, Dec., 1939); Spencer Gulf, Corney Point (K. Sheard, Feb., 1941) and Port Lincoln and Memory Cove, 3 fath. (type loc., K. Sheard, submarine light, Feb. 1944). Queensland: Moreton Bay, Myora Bight, surface (ovigerous female, I. S. R. Munro, Station 42, 50 cm. 40 m., net, 7 p.m., Nov. 29, 1940 and males from other stations in the Bay, Nov.-Dec., 1940). Types in South Australian Museum, Reg. No. C. 2577–2578.

This appears to be the commonest *Nannastacus* of the South Australian coast. Ovigerous females and juveniles were previously referred to *gibbosus* by the writer. Calman's species is described from the adult female only and this is separated from that of *inflatus* by having (1) the pseudorostral lobes meeting below; (2) the third joint of peduncle of first antenna longer than the second; (3) the exopod of the uropod, with its spine, relatively longer, while the endopod has "five small spines on its inner edge." Also, Calman does not figure the two dorsal tubercles at hinder margin of the fifth pleon somite but the non-articulated spines of the integument show some variation in *inflatus*.

The adult males of *inflatus* are of two sizes, approximately 2·1 mm. and 2·2 mm. in length. The larger males were regarded *ut supra* as *zimmeri* Calman but the male of the last-named differs (1) in the smaller size, 1·6 mm.; (2) the pseudorostral lobes are not widely open above; (3) the carpus of the fifth peraeopod is half as long again as the propodus; (4) the exopod of the uropod with its spine is longer, reaching beyond middle of length of endopod.

N. inflatus also has affinities with the smaller *sauteri* Zimmer (1921, p. 135, fig. 30–37) but is separated by the characters given in the keys.

The single female from Queensland is 2·1 mm. in length but the largest of the males taken by Mr. Munro measure over 2·5 mm.; these males have the uropods and other appendages as in the southern specimens but the furrows between the tumidities of the carapace are less pronounced, a feature possibly produced by four years of immersion in formalin.

NANNASTACUS SUBINFLATUS sp. nov.

Nannastacus zimmeri Hale (*part.*, *nec* Calman) 1936, p. 432.

Ovigerous female. Integument with granules as in *inflatus* and with sparse, rather long hairs.

Carapace large, fully two-fifths of total length; it is widest across the branchial regions, where the breadth is considerably greater than its depth and is equal to four-fifths its length; although each branchial region is inflated there is no deep furrow between the swellings as in *inflatus*, nor, viewed from above, is there a marked constriction anterior to them; posteriorly is a median tumidity, not prominent as seen from the side, and having at its hinder end a pair of tubercles larger than the general granules. Antero-lateral margin deeply concave and angle produced, tooth like. Pseudorostral lobes as in *inflatus* but a little shorter; not meeting above or below.

Pleural parts and lower part of sides of first pedigerous somite exposed; dorsal tumidity of fifth with a pair of tooth-like tubercles, which stand out amongst the smaller granules; first to third somites as wide as carapace, the pleural parts being considerably expanded but not backwardly produced.

First and second pleon somites with dorsum slightly elevated, each with a pair of acute tubercles as on last pedigerous somite; fifth distinctly longer than

any of the others, less than half as long again as wide; telsonic somite as wide as long, slightly dilated towards posterior end which is roundly sinuate.

First antenna as in *inflatus*.

Third maxilliped without exopod; ischium relatively large and distinct.

First peraeopod with propodus not longer than carpus and much less than twice as long as dactylus.

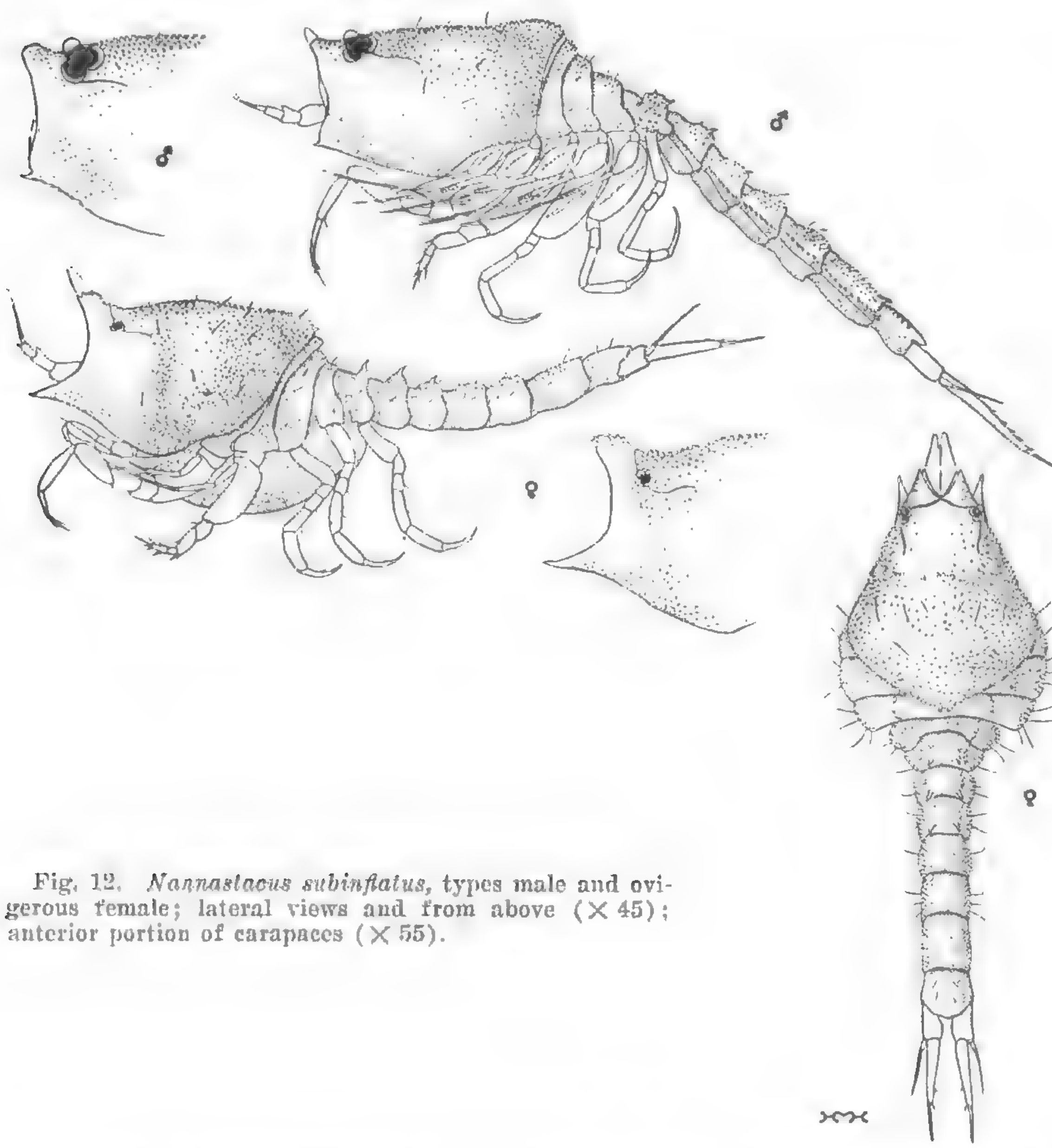

Fig. 12. *Nannastacus subinflatus*, types male and ovigerous female; lateral views and from above (× 45); anterior portion of carapaces (× 55).

Carpus of fifth peraeopod a little longer than propodus (shorter than it is in *inflatus*).

Peduncle of uropod more than three-fourths as long as telsonic somite and fully half as long as endopod, exclusive of its distal spine; exopod almost one-sixth as long as endopod and with its terminal spine reaching almost to five-sixths of length of latter; endopod with two short spines on inner margin and with its distal spine more than half the length of the ramus.

Colour dull yellow.

Length 1·4 mm. (ova in greatest diameter 0·18 mm.).

Adult male. As in the female there are paired spiniform tubercles on the back of the last pedigerous and first two pleon somites, while the terminal joints of the peraeopods are of the same proportions. Carapace fully one-third of total length of animal, less inflated than in male of *inflatus* and with dorsal outline more regular. Antero-lateral angle and pseudorostral lobes much as in *inflatus*.

Only a narrow strip of first pedigerous somite exposed.

Upper margin of antennal groove of first to fifth pleon somites quite strongly spinose; fifth somite more than half as long again as wide, with a pair of spiniform tubercles at hinder margin; telsonic somite slightly longer than wide.

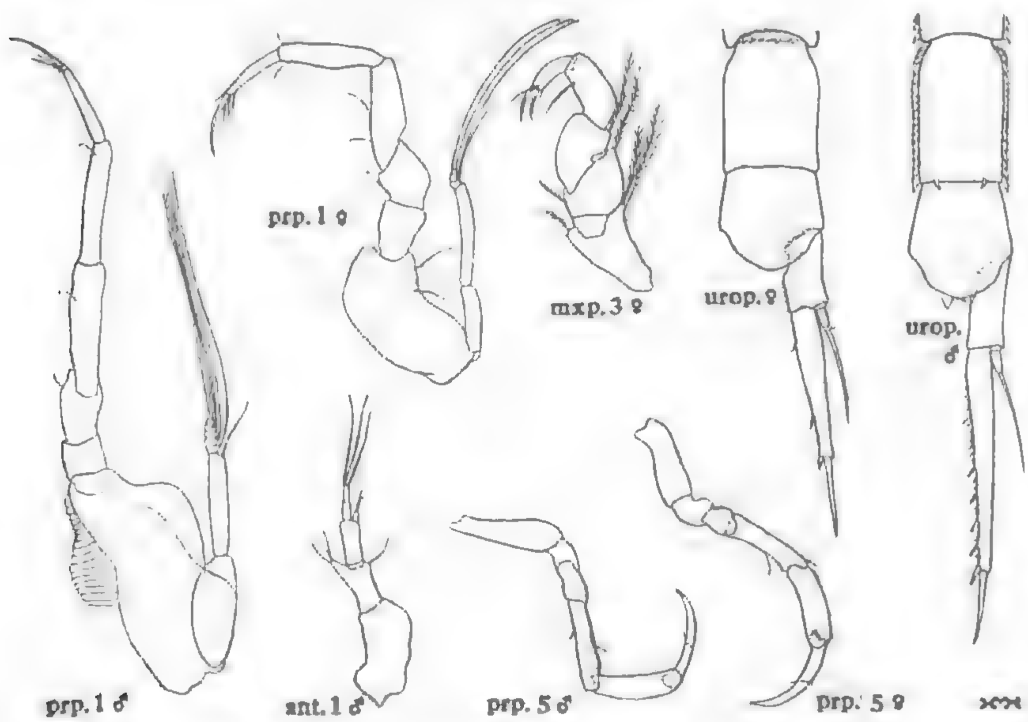

Fig. 13. *Nannastacus subinflatus*, paratypes male and ovigerous female; ant., mxp. and prp., first antenna, third maxilliped and peraeopods; urop., uropods with fifth pleon and telsonic somites (all × 86).

Peduncle of uropod more than three-fourths as long as telsonic somite, and two and one-half times in length of endopod, exclusive of its terminal spine; exopod about one-eighth as long as endopod and with its distal spine reaching distinctly beyond middle of length of latter; endopod with five short spines on inner margin and with terminal spine one-third as long as its ramus.

Length 1·7 mm.

Loc. South Australia: St. Vincent Gulf, Sellick's Reef, on stones, 1 fath. (H. M. Hale, Apl., 1936) and off Brighton jetty (type male, Misses P. Mawson and L. M. Angel, submarine light, Oct., 1941) and Port Willunga, on reef (type female, Hale, Apl., 1944); Spencer Gulf, Memory Cove, 3 fath. (K. Sheard, submarine light, Feb 1944) and other localities in both Gulfs. Types in South Australian Museum, Reg. No. C. 2588 and C. 2612.

The smaller males previously identified by the writer as *zimmeri* Calman are referred here. *N. subinflatus* is very like Calman's species but the last-named differs in having the pseudorostral lobes meeting below, and in the male for a short distance above also, the pleon is without spines, while the carpus of the fifth leg is

nearly half as long again as the propodus, and the endopod of the uropod is three times as long as the peduncle; as these differences are constant in a long series of South Australian specimens the latter are now regarded as representative of a distinct species.

N. subinflatus occurs in the same situations as *inflatus;* it may be distinguished by the smaller size, the different shape of the carapace and the proportions of the peraeopods and uropods; it will be noted that the inner margin of the endopod of the last-named (as in *zimmeri*) bears two short spines in the female and five in the male as against three and six in the sexes of *inflatus* and *johnstoni*.

NANNASTACUS LIMA (Hale).

Cumella lima Hale (female only), 1936, p. 435, fig. 22 and fig. 23, a–g.

Although the eyes are much closer together than is usual in the females of species of *Nannastacus*, they are paired; each has three corneal lenses and is separated from its fellow by a distance less than its breadth. The larger eyes of the males of *brachydactylus* Calman and *nasutus* Zimmer are similarly narrowly separated.

An ovigerous female recently collected in Table Bay, Tasmania, has the form slightly more robust than in South Australian examples, is a trifle smaller (1·3 mm.) and the granulation of the integument is quite distinct. The antero-lateral corner of the carapace is subacute and the lower margin immediately posterior to it is serrate. The third maxilliped has an exopod. The peraeopods are much as described for *sheardi* but the carpus of the fifth peraeopod is less than half as long again as the propodus.

A few subadult males from Tasmania have the uropods as in the female excepting that exopod and peduncle are very slightly longer in relation to the endopod, which has three distal spines distinctly marked off on inner margin. The fifth pleon somite, as in the female, is only half as long again as wide.

NANNASTACUS JOHNSTONI sp. nov.

Ovigerous female. Integument almost smooth, shining, sparsely clothed with long hairs.

Carapace relatively large and robust, three-sevenths of total length of animal and nearly three times as long as pedigerous somites together; across the inflated branchial regions it is wider than deep, while it is less than twice as long as deep; the antero-lateral regions are somewhat swollen, there being a noticeable lateral depression between these tumidities and the swollen branchial areas; back of carapace rather flat, slightly rounded along midline and with a median tumidity at hinder end. Antero-lateral margin angularly concave and antero-lateral angle well marked, produced and subacute. Pseudorostrum directed upwards, the lobes gaping above and below, and not meeting to any appreciable extent; front of lobes as seen from side rounded and subtruncate, with indefinite serrations.

Pleural parts and a narrow strip only of first pedigerous somite exposed; second also very short dorsally (where it is elevated) but like first and third greatly expanded laterally and wider than the carapace; fourth and fifth somites each with back slightly raised.

Pleon somites short and stout; first deeper and wider than long, with dorsum tumid; fifth longer than the others, but less than half as long again as wide; telsonic somite rounded posteriorly, barely longer than wide.

Third joint of peduncle of first antenna shorter than second and less than half as long as first.

Third maxilliped without exopod and with ischium poorly defined; propodus a little longer than carpus.

First peraeopod with basis very short, much less than half as long as the elongate remainder of limb; propodus little longer than carpus and less than twice as long as dactylus.

Second peraeopod two-thirds as long as first; basis subequal in length to rest of limb; carpus not much longer than merus, and about as long as propodus and dactylus together: dactylus short and broad, little longer than propodus, and shorter than its longest distal spine.

Carpus of fifth peraeopod shorter than propodus, which is longer than dactylus.

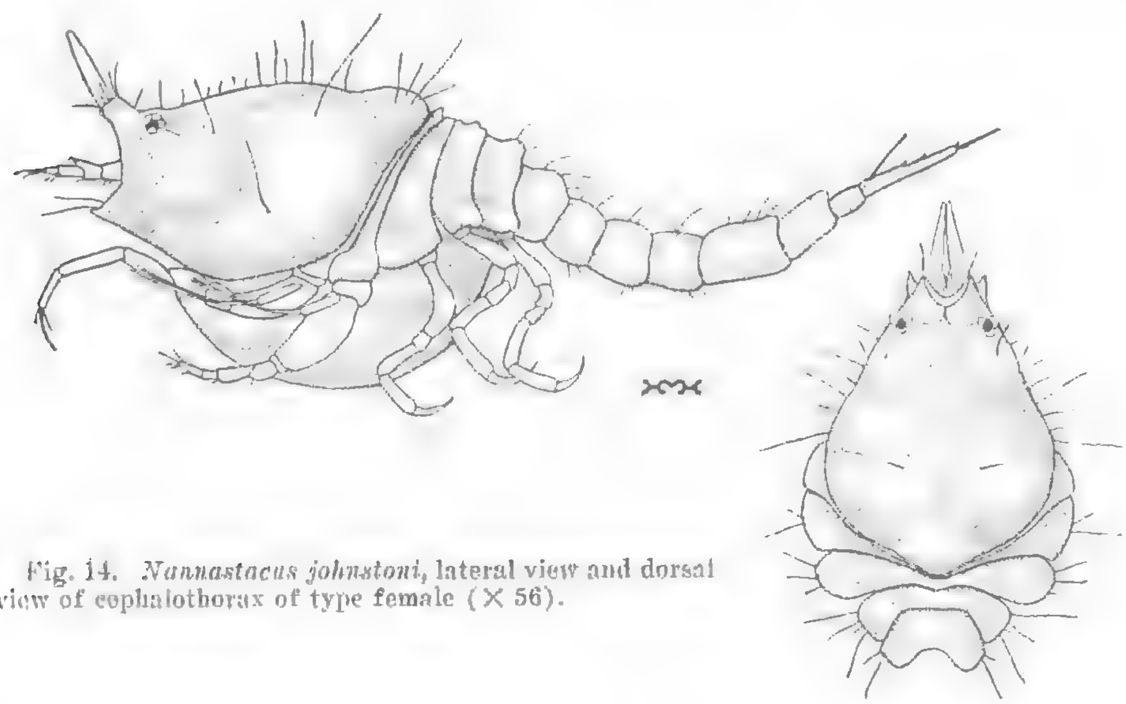

Fig. 14. *Nannastacus johnstoni*, lateral view and dorsal view of cephalothorax of type female (× 56).

Peduncle of uropod, two thirds as long as telsonic somite and half as long as endopod, exclusive of its terminal spine; exopod fully one-seventh as long as exopod and with its terminal spine reaching just beyond three-fourths of length of latter; endopod with three short spines on inner margin, all equal in length, and with terminal spine half the length of ramus.

Length 1·45 mm. Ova in greatest diameter 0·15 mm.

Colour yellow, with dorsum pale brown.

Adult male. The usual sexual differences are exhibited. The basis of the first four peraeopods is very wide (about twice as long as wide) and there are the usual lamellate teeth on the anterior pairs (see fig. 15).

Uropod relatively longer than in female; peduncle three-fourths as long as telson, and less than half as long as endopod exclusive of terminal spine; exopod less than one-eighth as long as endopod and with its terminal spine reaching just beyond middle of length of latter; endopod with six spines on inner margin, successively increasing a little in length backwards, and with distal spine fully one-third length of ramus.

Length 1·5 mm.

Loc. New South Wales: Sydney; Vaucluse, on stones, between tide marks (type loc., T. H. Johnston, Jan., 1937) and Shark Island, on stones (K. Sheard,

Feb., 1938). Queensland: Moreton Bay, Myora Bight, surface (I. S. R. Munro, various stations, 50 cm. 40 m. net, Nov., 1940). Types in South Australian Museum, Reg. No. C. 2580–2581.

The species is named after Prof. T. Harvey Johnston, who first collected it. The formalin treatment of silt-covered stones produced a good number of ovigerous females which are of two sizes, approximately 1·5 mm. and 1·95 mm. in length.

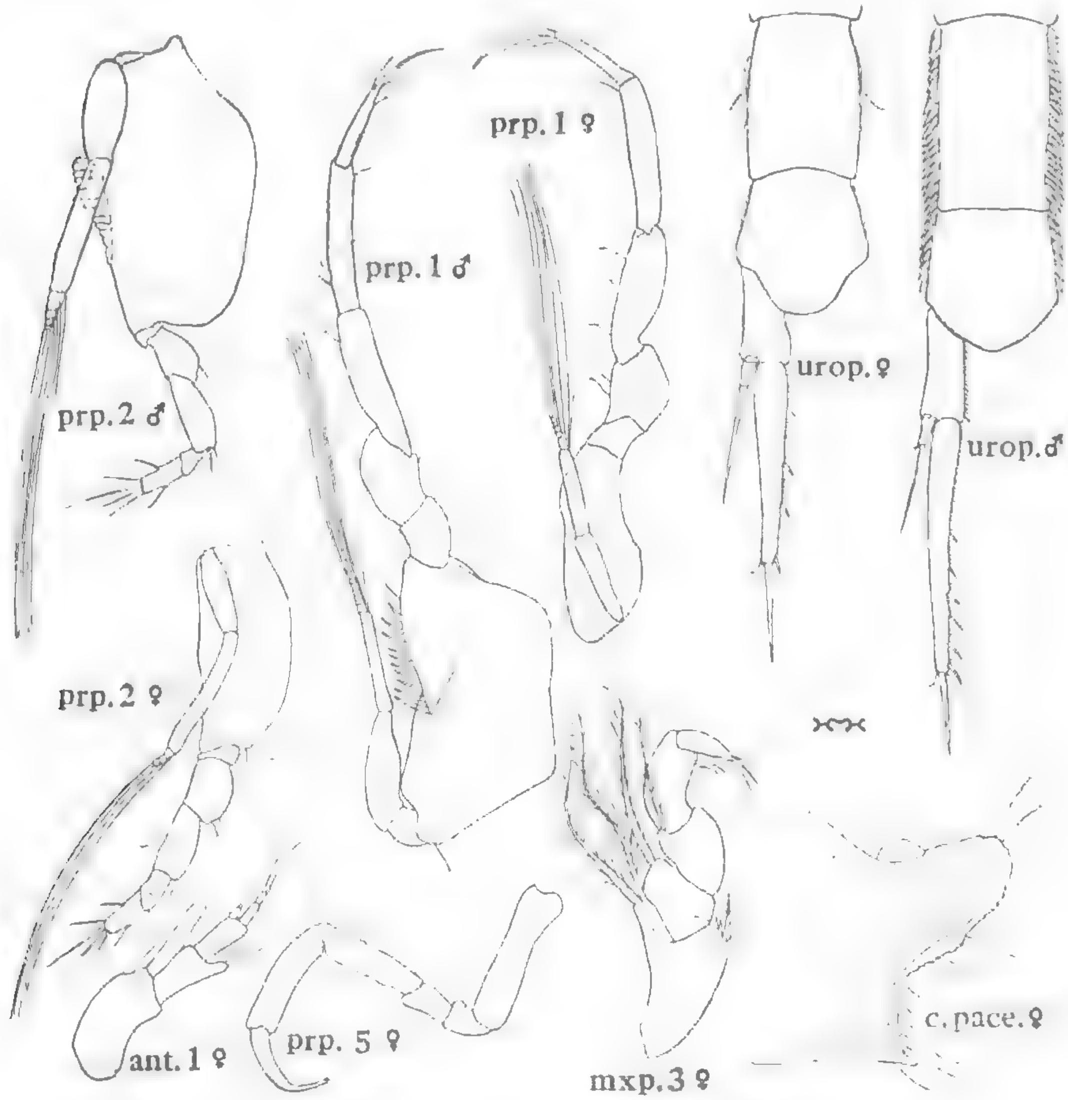

Fig. 15. *Nannastacus johnstoni*, paratypes adult male and ovigerous female; c. pace, anterior portion of carapace, somewhat flattened; ant., mxp. and prp., first antenna, third maxilliped and peraeopods; urop., uropods with fifth pleon and telsonic somites (all × 108).

This would seem to be the common *Nannastacus* in Sydney Harbour. It is close to *minor* Calman (1911, p. 357, pl. xxxiv, fig. 1–3); but has the exopod of the uropod relatively shorter in the female, with its distal spine not reaching nearly to distal end of endopod; further, while the branchial regions are more inflated than in Calman's species, there is no median dorsal depression between the tumidities in this sex.

Mr. Munro secured a good number of males only and the species is evidently abundant in Moreton Bay, Queensland, also. These males range in size from 1·5

mm. to just over 2 mm. but the appendages show no differences. They were taken in company with males of *inflatus*, which are distinguishable because of the slightly different uropods, in which the peduncle is relatively shorter, the distal spine of the exopod does not quite reach to middle of length of endopod (exclusive of terminal spine) and the distal spine of the endopod is not quite so long, being less than one third the length of the ramus; further, the dactylus of the first peraeopod is slightly shorter in relation to the propodus of that limb.

Genus SCHIZOTREMA Calman.

Schizotrema Calman, 1911, p. 360; Stebbing, 1913, p. 165 (key).

SCHIZOTREMA ACULEATA Hale.

Schizotrema bifrons Hale (*nec* Calman), 1936, p. 429; fig. 18.

Schizotrema bifrons var. *aculeata* Hale, *loc. cit.*, p. 430, fig. 19.

Further Australian specimens are available. As the body armature differs always from that described by Calman (1911, p. 362, pl. xxxiv, fig. 18–21) for his *bifrons* from the Gulf of Siam the name *aculeata* may be applied to the Australian form. The delicate spines are easily damaged, but as previously mentioned they do show some variation. Ovigerous females and fully adult males, assumed to belong together, exhibit quite considerable differences in this direction.

S. bifrons is described from the female only. Females and almost adult males of *aculeata* have the spinulation much more marked than in the female of *bifrons*, with at least one pair of outstanding dorsal spines, and a similar large lateral spine on each side of the second to fifth peraeon somites and on all the pleon somites; the side spines are particularly prominent when the animal is viewed from above (see posterior portion of pleon of female and subadult male in fig. 16). The surface dorsally and laterally bears tiny spinules and some small spines. The fifth pleon somite is as wide as long and is not longer than the telsonic somite; the longest dorsal and lateral spines are equal in length to about half the width of the somite.

Adult male. Fully mature males of the same size as ovigerous females (approximately 1·7 mm.) and taken by submarine light at Port Lincoln, South Australia, are here regarded as belonging to *aculeata* because the arrangement of the spines of the dorsum is essentially the same, although the spines themselves are shorter. There are no very large lateral spines as in the adult female and young male.

The carapace is depressed, two-fifths of total length of animal and twice as long as the pedigerous somites together; at the rear is a triangular, low tumidity which is not produced backwards and which is margined on each side by a pair of deep grooves, converging from the posterior end to meet in the mid-line between the branchial regions, and thence diverging to meet a tumidity behind each eye; dorsally and dorso-laterally it is covered with spines, which become tubercular on the lower parts of the sides; one or two spines behind the eyes are larger than the others and there is a conspicuous spine below the pseudorostrum, directed outwards from the front. Antero-lateral corner angular, not produced and with a small spine, behind which is a row of spinules.

First peraeon somite exposed as a narrow strip; second to third about as wide as carapace, with pleural parts expanded and armed with spines larger than those of sides; dorsal pair of spines on second and third not larger than pleural spines, on fourth longer, and on fifth as long as longest dorsal spines of first to fourth pleon somites.

Fifth pleon somite fully as wide as long and about as long as telsonic somite, with a row of four or five spines (which successively increase in size) on each side of dorsum; back of telsonic somite with median spine as in female, with dorso-lateral spines short, and with only insignificant lateral spines.

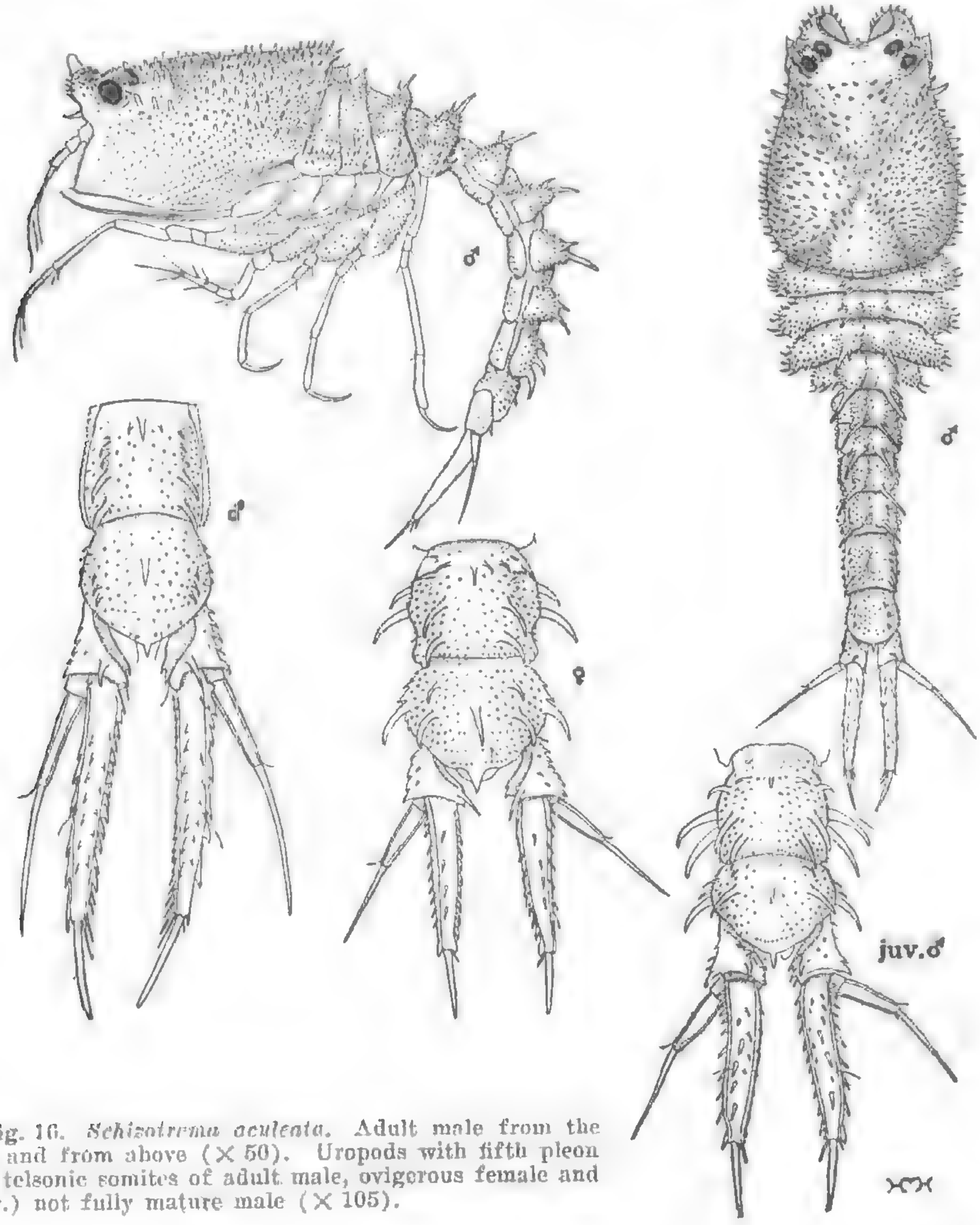

Fig. 16. *Schizotrema aculeata.* Adult male from the side and from above (× 50). Uropods with fifth pleon and telsonic somites of adult male, ovigerous female and (juv.) not fully mature male (× 105).

On the fourth and fifth peraeon and first to fourth pleon somites there is a longitudinal, median depression between the paired elevations bearing the spines. First antenna with second and third peduncular joints subequal in length, each half as long as the first; accessory flagellum single jointed, about one-fourth as long as first joint of main flagellum.

Third maxilliped with basis longer than rest of limb; merus with an outer subdistal spine, preceding the usual plumose seta, which like one of the two on the outer apical lobe of the basis is unusually stout.

First peraeopod with slender terminal joints together more than half as long again as basis; ischium with a strong distal outer spine and merus with smaller spine in same position; carpus and propodus subequal in length, and dactylus less than two-thirds as long as either.

Second peraeopod with basis about equal in length to remainder of limb; carpus subequal in length to dactylus and twice as long as merus; dactylus three times as long as propodus, with longest terminal seta equal in length to propodus plus dactylus.

Fifth peraeopod with carpus more than half as long again as propodus, which is longer than the dactylus.

Peduncle of uropod more than half as long as telsonic somite and less than one-third as long as endopod exclusive of its terminal spine; exopod nearly half as long again as peduncle, half as long as endopod and with its distal spine reaching to just beyond distal end of last-named; terminal spine of endopod stout, two-fifths as long as its ramus.

Ovigerous females have the rami of the uropod relatively shorter (endopod barely more than twice as long as peduncle, and exopod as long as peduncle); distal spines of same length in proportion to rami.

Almost mature males (fig. 16, juv.) with lateral body spines as in the female, have the rami of the uropod intermediate in length between those of the ovigerous female and adult male.

Two males from Moreton Bay, Queensland (tow-net at night, Nov.–Dec., 1940, I. S. R. Munro) are smaller than the southern specimens (1·5 mm.) and differ in having the spinulation of the carapace far less developed, with the spine below pseudorostral lobes insignificant. In one of them the dorsal processes of the pleon somites are more slender and there are no fairly large spines near the base of the long and prominent apical spine of each elevation, the slope of which bears only small spinules; the second male has the pleon armature as figured.

Genus CUMELLA Sars.

Cumella Sars, 1864, p. 198; Calman, 1911, p. 344 (key); Stebbing, 1913, p. 178 (syn. and key).

Nine species can be added to the genus since Stebbing's revision, three from the Northern Hemisphere (Hansen, 1920, pp. 29–30, pl. ii, fig. 4–5 and Hart, 1930, p. 15, fig. 5, A–D) three from South-Western Australia (Zimmer, 1914, pp. 179–182, fig. 4–9), and three now proposed.

Zimmer has suggested that *Nannastacus hirsutus* Hansen should be referred to *Cumella* because of the close set eyes of the female. *Cumella lima* Hale (1936, p. 435) has the eyes separated by a very narrow interspace in the female but it is now considered that the species belongs to *Nannastacus*.

It is perhaps scarcely practicable to describe newly discovered species so exhaustively as to preclude any possibility of confusion regarding others subsequently found. For example *Cumella hispida* and *laevis* Calman may be mentioned. There occur in Australian waters several forms distinct from each other and allied to these two species but apparently separable from them. One of these, from southern Australia was formerly recorded provisionally as *laevis* (Hale, 1936, p. 432); another, now available from Queensland, is, in the proportions of the uropods, still closer to *laevis* but the armature of these appendages is different. The relatively slight features distinguishing these two Australian forms from *laevis*, as described from the Gulf of Siam, are constant in long series and both are herein regarded as new; eventually they may be considered varieties or subspecies but in any case separate names seem to be desirable.

The status of the material herein referred to *hispida* remains in some doubt pending further details of the species.

KEY TO AUSTRALIAN SPECIES OF *CUMELLA.*

1. Peduncle of uropod distinctly longer than telsonic somite .. .. .. 2.
   Peduncle of uropod at most only as long as telsonic somite .. .. .. 5.
2. Carapace with a marked dorsal tumidity at posterior end .. .. *gibba* Zimmer.
   Carapace with no tumidity at posterior end .. .. 3.
3. Carapace well arched dorsally. Pseudorostral lobes not projecting in front of ocular lobe. Exopod of uropod much shorter than endopod .. .. *cycluspoides* Zimmer.
   Carapace with dorsal edge practically horizontal. Pseudorostral lobes projecting in front of ocular lobe to form a short but distinct pseudorostrum. Exopod of uropod as long, or almost as long, as endopod .. .. 4.
4. Inner margin of endopod of uropod with spines along practically whole length *munroi* sp. nov.
   Inner margin of endopod of uropod with spines restricted to distal third .. *cana* sp. nov.
5. Terminal spines of rami of uropods not distinctly marked off .. .. .. 6.
   Terminal spines of rami of uropods distinctly marked off .. *turgidula* sp. nov.
6. Adult female with two small median dorsal spines on carapace and with pleon not much shorter than cephalothorax. Carpus of fifth peraeopod much longer than ischium and merus together .. .. *hispida* Calman.
   Adult female with no dorsal spines on carapace and with pleon only three-fourths as long as cephalothorax. Carpus of fifth peraeopod not much longer than ischium and merus together *michaelseni* Zimmer.

CUMELLA MUNROI sp. nov.

Ovigerous female. Form as in *laevis* Calman, the back of the carapace almost horizontal and the pseudorostrum very short and truncate in front. Integument with short sparse hairs.

First antenna with last two joints of peduncle subequal in length, and first joint two-thirds as long again as either; accessory flagellum distinct, main lash not longer than last peduncular joint.

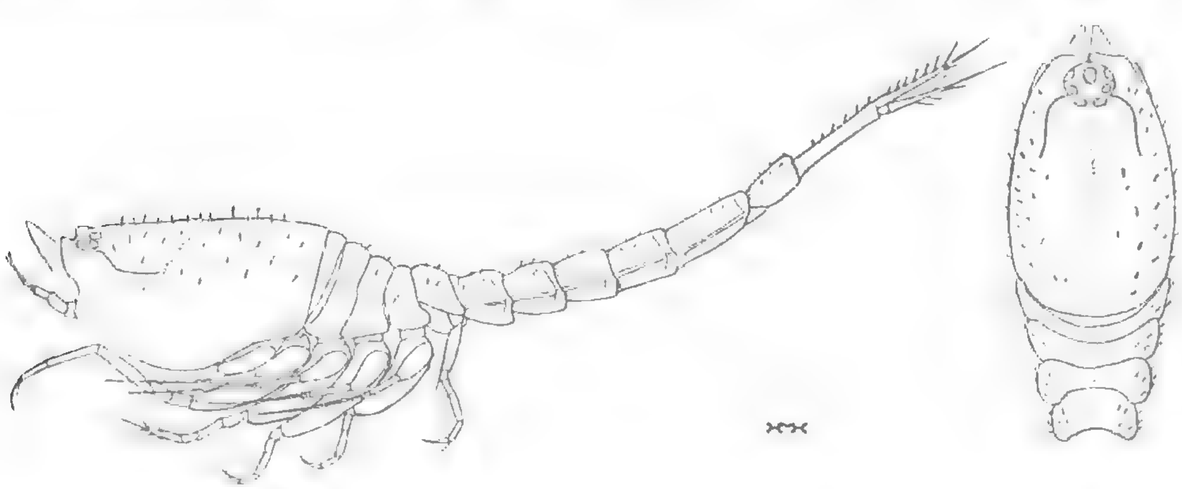

Fig. 17. *Cumella munroi,* lateral view and dorsal view of cephalothorax of type adult male (× 50).

First peraeopod with basis, as in *laevis,* short, less than half as long as rest of limb; carpus shorter than propodus and dactylus together; propodus two-thirds as long again as dactylus.

Second peraeopod with basis about four-fifths as long as rest of limb; dactylus as long as carpus and propodus together and almost as long as merus and carpus together; longest terminal spine of dactylus as long as the joint.

Fifth peraeopod with carpus nearly half as long again as propodus, which is not as long as the slender dactylus.

Uropod with peduncle slender, two-third as long again as telsonic somite and with six short spines (as well as usual minute spinules) on inner margin; endopod, as in female *laevis*, two-thirds as long as peduncle, but with seven spines spaced along length of inner margin and with long terminal spine three-fourths as long as ramus; exopod as long as endopod, with longest of the two unequal terminal spines almost as long as its second joint.

Length 1·6 mm.

Adult male. Carapace more than one-third of total length of animal; three-fourths as long again as deep and as wide as deep. Pseudorostral lobes meeting for a distance equal to less than one-third length of ocular lobe, which is large, fully as wide as long, rounded and with seven large corneal lenses. Antero lateral margin concave and angle obtuse.

Pedigerous somites together four-sevenths as long as carapace; pleural parts of first concealed, those of remainder slightly expanded.

Pleon not much shorter than cephalothorax; fifth somite half as long again as telsonic somite, which is (as in female) little longer than wide and not markedly produced posteriorly.

Peraeopods with joints, apart from the longer basis, of same proportions as in female.

Uropods with peduncle fully twice as long as telsonic somite; endopod two-thirds as long as peduncle and with terminal spine more than three-fourths as long as ramus; exopod with longer terminal spine almost as long as whole ramus; other armature of rami and peduncle as in female.

Length 1·6 mm.

Loc. Queensland: Moreton Bay, Green Island, surface (I. S. R. Munro, Station 1, 40 cm. 60 m., net, 7 p.m., Jan. 20, 1940) and Myora Bight, surface (I. S. R. Munro, Stations 27, 28 and 55 [type loc.], 1.30 a.m., 2.30 a.m. and 9.40 p.m., Nov. 29, 1940 and Dec. 6, 1940). Types in South Australian Museum, Reg. No. C. 2631.

While only a single ovigerous female was taken by Mr. Munro's surface nettings, males are abundant in the night hauls mentioned, but only three were secured at Station 1.

Although as aforementioned, the uropods in their slenderness and proportions resemble those of *laevis*, their armature, constant in the series, is quite distinctive.

CUMELLA CANA sp. nov.

Cumella laeve Hale (*nec* Calman), 1936, p. 432, fig. 20–21.

The differences between the southern Australian material and the female described by Calman are discussed *ut supra*. The uropods in *cana* have the peduncle wider, less than six times as long as broad (about ten times in *laevis*), serrate on inner edge and with the terminal spine of the endopod barely half the length of the ramus instead of fully two-thirds as long as it; normally there are four inner spines on this ramus in the male but rarely there are five; the endopod in the female has three or four inner spines. The name is given in allusion to the grey colouration.

In fig. 18 the appendages of *cana* are compared with those of *munroi*. The former differs in that (1) the first peraeopod has the carpus longer than propodus and dactylus together, and the lamellate spines at the edge of the exopodal recess of the basis are stronger; (2) the second peraopods have the dactylus much shorter than merus and carpus together; (3) the dactylus of the fifth peraeopod is shorter; (4) the uropods are stouter, with different armature and with peduncle shorter in relation to telsonic somite and endopod.

Loc. South Australia: St. Vincent Gulf, Sellick's Reef (type loc., H. M. Hale, Mar.–Apl., 1936) and Brighton on shingle bar (K. Sheard and B. C. Cotton, Mar., 1937), and Port Willunga on reef (H. M. Hale, Apl., 1944); Spencer Gulf, Memory Cove, 3 fath. (K. Sheard, submarine light, 8 to 8.30 p.m., Feb., 1941); Kangaroo Island, Antechamber Bay, 4 fath. (K. Sheard, submarine light, 8 to 8.30 p.m., Apl., 1941). Types in South Australian Museum, Reg. No. C. 2032.

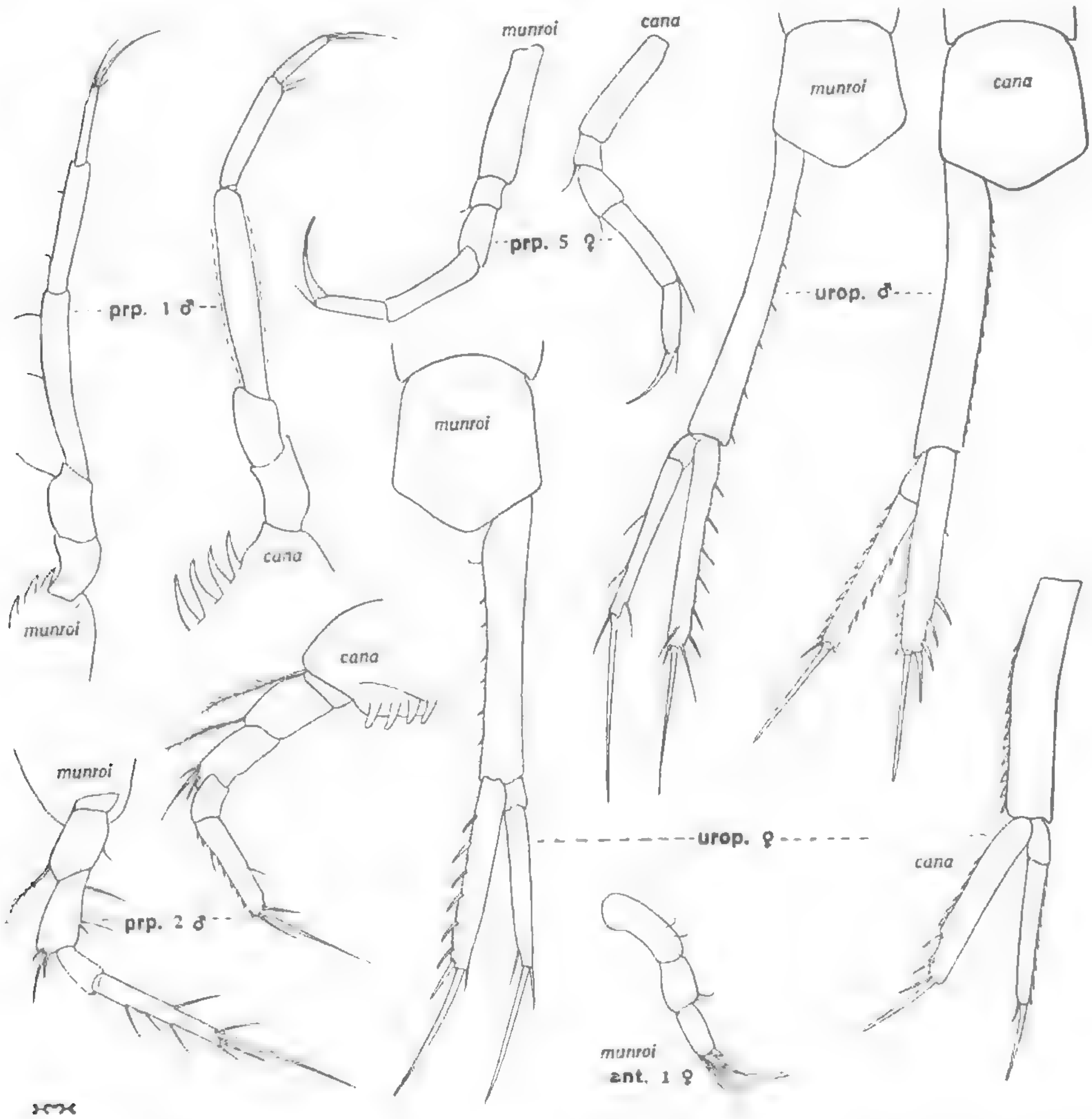

Fig. 18. *Cumella munroi* and *C. cana*; ant., prp. and urop., first antenna, peraeopods and uropods (× 145).

Adult males range in length from 1·6 mm. to 1·84 mm. One of the larger examples has the uropods as figured (although with five inner spines on endopod) but the proportions of the first and second peraeopods differ slightly in that the dactylus of the first pair is only half as long as propodus, while that of the second is not much longer than the carpus. The main and most prominent difference in this exceptional example lies, however, in the fifth leg, which is relatively half as long again as in other individuals and has the carpus four-fifths as long again as

propodus. Also, this peraeopod is here as long as the second leg, whereas in typical males (seemingly fully adult, and with long setae on the thoracic exopods) it is much shorter than that limb and has the carpus only about half as long again as propodus. As noted elsewhere, the attainment of complete sexual maturity by the male of some other Cumacea results in considerable changes and one may venture to suspect in this case the possibility of two forms of this sex, both apparently adult: this assumption, however, should be viewed with caution and there is the possibility that the long-legged male represents another species.

CUMELLA TURGIDULA sp. nov.

Adult male. Integument of back and sides granulate, the granules rather more conspicuous on pedigerous somites than on carapace, and clothed with short yellow hairs which become sparser on the pleon.

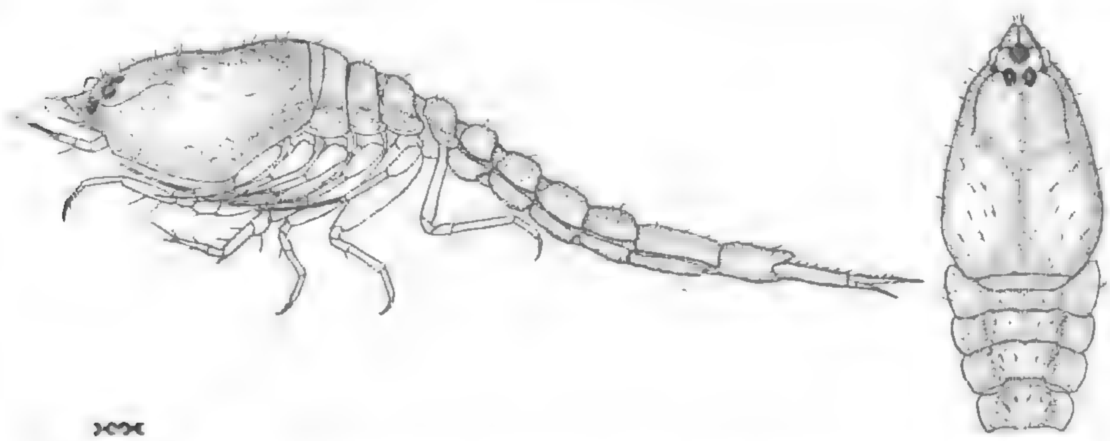

Fig. 19. *Cumella turgidula*, lateral view and dorsal view of cephalothorax of type male (× 23).

Carapace not quite one-third of total length of animal; a little depressed and nearly twice as long as deep; seen from above it tapers towards the front and is widest across the branchial regions which are somewhat inflated; there is a low, median carina, interrupted between the branchial tumidities by a short broad furrow: at the posterior end of each pseudorostral suture there is a small boss; seen from the side the pseudorostrum is not upturned, its concave upper margin curving back and up to above the eye; thence the dorsal contour is arched, with a depression behind middle of length, posterior to which is a low hinder tumidity. Antero lateral margin shallowly concave and antero-lateral corner rounded, obtusely-angular. Pseudorostral lobes meeting in front for a distance equal to fully half length of ocular lobe; anteriorly they are subacute, crenulate, with a few setae and seen from the side very oblique. Ocular lobe wider than long, with seven large corneal lenses, one pair colourless, the others black.

First pedigerous somite exposed above, concealed on lower part of side by the anterior pleural lobe of second; third to fifth with pleural parts expanded and slightly backwardly produced; second almost as wide as carapace and, like the third, with a faint median carina.

First four pleon somites subequal in length, each distinctly shorter than the fifth, which is narrow, twice as long as wide; telsonic somite almost as long as fifth, less than twice as long as wide, scarcely dilated posteriorly, produced above bases of uropods where it is rounded with a small median terminal point: back of all somites rounded without trace of median ridge.

First joint of peduncle of first antenna twice as long as third, which is barely shorter than second; second joint of flagellum not much shorter than first; accessory lash single-jointed, minute.

Second antenna with flagellum reaching just beyond end of pleon.

Third maxilliped with ischium short and propodus half as long again as carpus.

First peraeopod with carpus not quite reaching level of antennal angle; basis as long as ischium to propodus together; ischium and merus subequal in length; carpus about two and one-third times as long as merus and one-third as long again as propodus, which is twice as long as the short dactylus.

Second peraeopod with basis as long as rest of limb; ischium very short; carpus fully half as long again as merus and longer than dactylus, which is quite twice as long as propodus and has its longest terminal spine equal in length to itself.

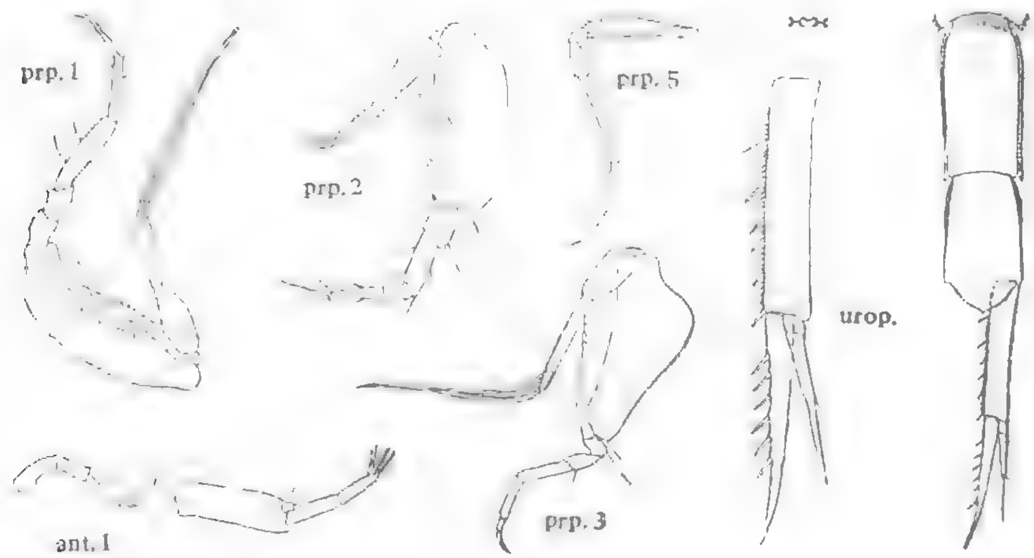

Fig. 20. *Cumella turgidula*, type male; ant. 1, first antenna (× 45; last peduncular joint and flagella, × 160); prp., peraeopods (× 45); urop., uropod (× 86); with fifth pleon and telsonic somites (× 45).

Fifth peraeopods with carpus more elongate than in preceding legs, nearly three times as long as merus and three-fourths as long again as propodus.

Peduncle of uropod equal in length to telsonic somite and barely longer than endopod, inclusive of its terminal spine; its inner margin is spinulose and is armed with six large spaced spines, successively decreasing in length towards the rear; exopod three-fourths as long as endopod, and as long as its stout terminal spine; endopod with six spines, equal in size, on inner margin and with a robust distal spine more than half as long as the ramus.

Colour: evenly shaded with brown excepting for the anterior part of carapace (where the colour merges into dark umber) and a pale yellow edging at margins of carapace and anterior and posterior edges of somites. First antennae brown, with edges of joints pale; other appendages translucent, save that the distal joints of the first legs are tinged with brown.

Length 2·9 mm.

Loc. South Australia: Spencer Gulf, Memory Cove, 3 fath. (*type loc.*, K. Sheard, submarine light, Feb., 1944); St. Vincent Gulf, Port Willunga, 1 fath., on reef (H. M. Hale, Apl., 1944). Type in South Australian Museum, Reg. No. C. 2572.

The type was taken in company with numerous males of *Nannastacus asper*, *inflatus* and *subinflatus*. It is close to *C. hispida* Calman (see below) but is a little larger than the female type of that species, and than the male which is here tentatively assigned to Calman's species. It differs in the proportions of the uropods and in having the terminal spines of the last-named separated off from the rami.

CUMELLA HISPIDA Calman.

Cumella hispida Calman, 1911, p. 347, pl. xxxii, fig. 11–14; Zimmer, 1914, p. 179.

Ovigerous female. Three examples 1·88 mm. to 2 mm. in length agree in general closely with Calman's description. The carapace has a shallow depression just anterior to the hinder margin and two small median teeth in the front half; there is a fine but distinct median carina for the whole length of carapace. Ocular lobe

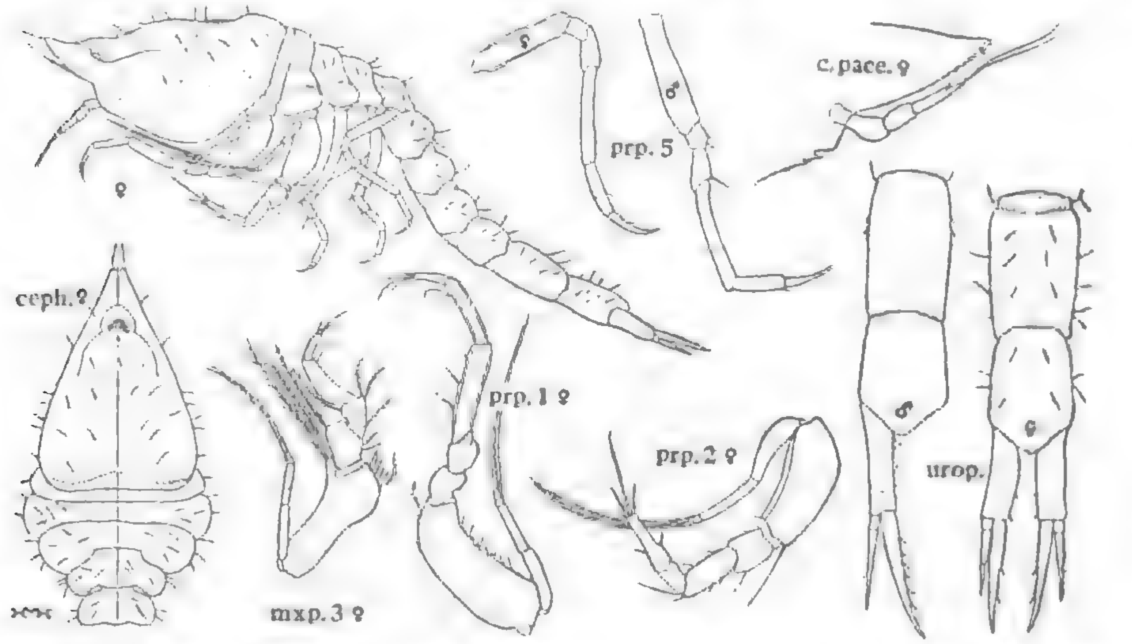

Fig. 21. *Cumella hispida*, ovigerous female and adult male; lateral view and (ceph.) cephalothorax from above (× 36); c. pace, anterior portion of carapace and first antenna (× 68); mxp. and prp., third maxilliped and peraeopods (× 68); urop., uropods with fifth pleon and telsonic somites (× 68).

wider than long, rounded, slightly constricted at base, and minutely incised at apex. Pseudorostral lobes pointed in front very oblique as seen from side and serrate near anterior ends; meeting in front of ocular lobe for a distance equal to one-sixth of length of carapace. Antero-lateral angle rounded, obtuse, and margin posterior to it serrate for a short distance.

Pedigerous somites expanded and swollen laterally; first fully as wide as carapace, second wider, and third but slightly narrower; each with a fine median carina.

Pleon four-fifths as long as carapace and pedigerous somites together; somites one to four with thin median ridge; fifth somite fully half as long again as wide, tapering towards the rear; telsonic somite not quite as long as fifth pleon somite, very slightly dilated posteriorly, somewhat angularly produced above bases of uropods and a little more than half as long again as wide.

First joint of peduncle of first antenna longer than third, which is longer than second; third joint at least three times as long as wide.

Basis of third maxilliped as long as rest of limb; ischium very short, propodus twice as long as dactylus, and half as long again as carpus which is subequal to merus; with exopod.

First peraeopod with basis only as long as ischium, merus and carpus together; the carpus is long, more than one-third longer than propodus, longer than ischium and merus together and three times as long as dactylus.

Basis of second peraeopod two-thirds as long as rest of limb and twice as long as dactylus; ischium distinct; carpus longer than ischium and merus together and as long as dactylus which is nearly twice as long as propodus, with its main terminal spine almost as long as its own length together with that of propodus.

Fifth peraeopod with carpus half as long again as propodus and little more than twice as long as merus, and a little shorter than basis.

Peduncle of uropod about three-fourths as long as telsonic somite and shorter than endopod, including stout terminal spine of latter, which is not distinctly marked off; exopod including distal spine more than two-thirds length of endopod; endopod and peduncle each with two small inner spines.

Colour lemon yellow, with faint shadings of brown on carapace.

Loc. South Australia: Port Willunga, on reef (H. M. Hale, April, 1944—example figured). Queensland: Moreton Bay, Myora Bight, surface (I. S. R. Munro, Nov., 1940).

The only differences leaving doubt as to the identity of these examples are (1) the smaller size; (2) the relatively shorter carpus of the fifth peraeopod; (3) the slightly different proportions of the uropod.

Adult male. General form as in *turgidula* sp. nov. Fifth pleon somite nearly twice as long as wide and a little longer than telsonic somite which is about half as long again as wide and is well produced posteriorly.

First peraeopod with basis longer than ischium to propodus together; carpus nearly half as long again as propodus, which is more than twice as long as dactylus.

Basis of second peraeopod as long as remaining joints together, the latter as in female described above.

Fifth peraeopod with carpus twice as long as propodus, two and one-half times as long as merus and little shorter than basis.

Peduncle of uropod a little shorter than telsonic somite and five-sixths as long as endopod including terminal spine which, as in the females recorded above, is not distinctly marked off; its inner edge bears a few short spines; exopod distinctly more than three-fourths as long as endopod which has six spines on inner margin, the last inserted just before the third fourth of length of ramus.

Length 2·15 mm.

Loc. Queensland: Moreton Bay, Myora Bight, surface (I. S. R. Munro, various stations, Nov., 1940).

Genus PICROCUMA Hale.

Picrocuma Hale, 1936, p. 415 and 1943, p. 338.

This genus was established on the female and was tentatively referred to the Bodotriidae. The male, now described, has exopods on the first three pairs of peraeopods (as in the female), pleopods are absent and the second antenna has a short and stout, prehensile flagellum. The mandible, as in *Campylaspis*, is moderately wide towards the base but the incisor process is narrow as in *Cumella* (interior part of base not shown in Hale, 1936, fig. 8b).

Picrocuma thus differs from all other Nannastacids in having an exopod on the third peraeopods of the female and none on the fourth pair of the male. The genus in other respects is not typical of the family. The antero-lateral corner of the carapace is not at all angular or prominent, the third maxillipeds are re-

markably pediform, the fossorial legs are stout and short, with basis not enlarged in exopod-bearing pairs of the male, and the uropods are relatively massive. The latter resemble those of *Campylaspis platyuropus* Calman (1911, p. 364, pl. xxiv, fig. 25–29) which by this character stands apart in its genus. The second male antennae resemble those of *Lamprops fuscata* Sars (1899, p. 20, pl. xi). For the present, however, it seems best to consider *Picrocuma* as an aberrant genus of the Nannastacidae.

PICROCUMA POECILOTA Hale.

Picrocuma poecilota Hale, 1936, p. 415, fig. 7–8 and 1943, p. 338, fig. 3–6.

Adult male. (Table Bay, Tasmania). Integument slightly roughened, somewhat polished.

Carapace small in relation to whole animal, barely longer than pedigerous somites together, two-sevenths of total length, distinctly compressed and with depth equal to nearly three-fourths its length; seen from the side the dorsal con-

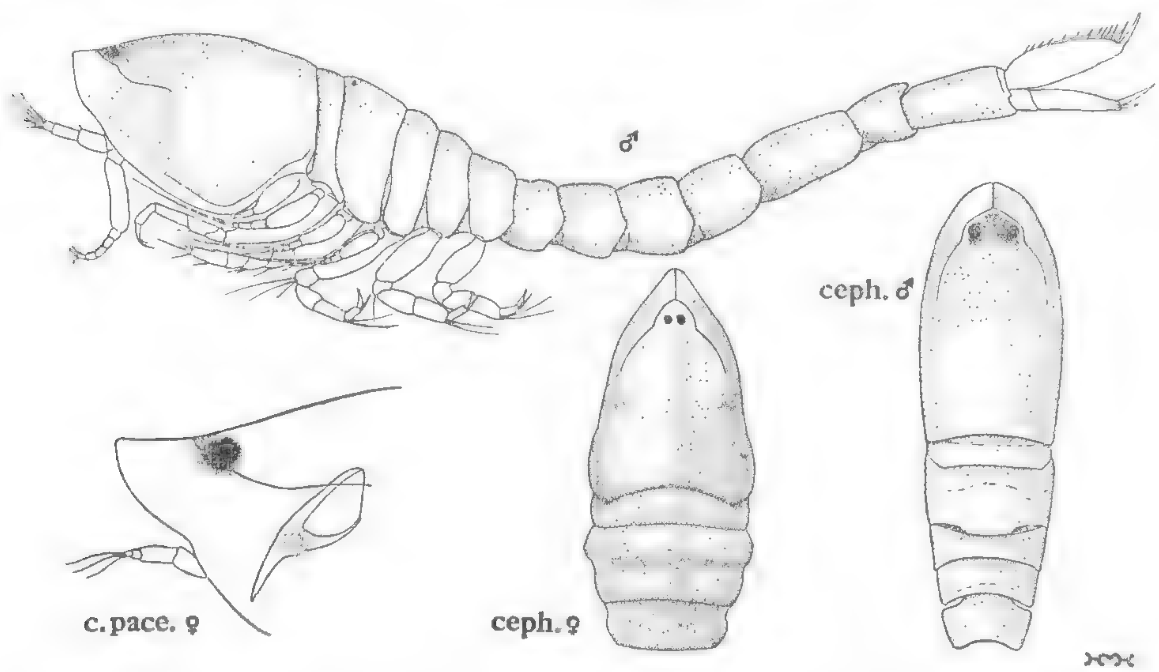

Fig. 22. ***Picrocuma poecilota.*** **Adult male, lateral view and (ceph.) cephalothorax from above (× 72). Adult female; c. pace, anterior portion of carapace showing outline of mandible (× 72); ceph., dorsal view of carapace and first three pedigerous somites (× 40).**

tour is slightly and smoothly arched, with a not very pronounced angle at base of pseudorostrum, which is not at all upwardly directed. Antero-lateral margin very shallowly concave and oblique; no indication of antero-lateral angle. Pseudorostral lobes roundly subtruncate in front, oblique as seen from the side, meeting in front of ocular lobe for a distance equal to one-tenth of length of carapace. Ocular lobe twice as wide as long, sooty and with a pair of darker areas apparently representing the eyes (fig. 22, ceph.).

All five pedigerous somites fully exposed; second much the longest, twice as long as third or fourth; fifth longer than fourth and first shortest of all; pleural portions scarcely or not at all expanded.

Pleon nearly twice as long as pedigerous somites together; somites one to four successively increasing in length; fifth abruptly longer, half as long again as fourth, and half as long again as wide; telsonic somite as wide as long, posteriorly rounded, little produced, and somewhat dilated, but not strikingly so.

First antenna almost as long overall as second; with third joint of peduncle barely shorter than second, and with first about as long as second and third together; first joint of main flagellum stout, wtih a dense brush of sensory filaments, which conceal at least a second joint.

Second antenna with flagellum stout, curved, subequal in length to last peduncular joint; five-jointed and apparently with a small terminal jointlet concealed by a dense series of setae emanating from the fifth joint.

The maxillae and first and second maxillipeds are as in *Cumella*. The last joint of the first maxilliped is elongate, more than two-thirds as long as the penultimate joint.

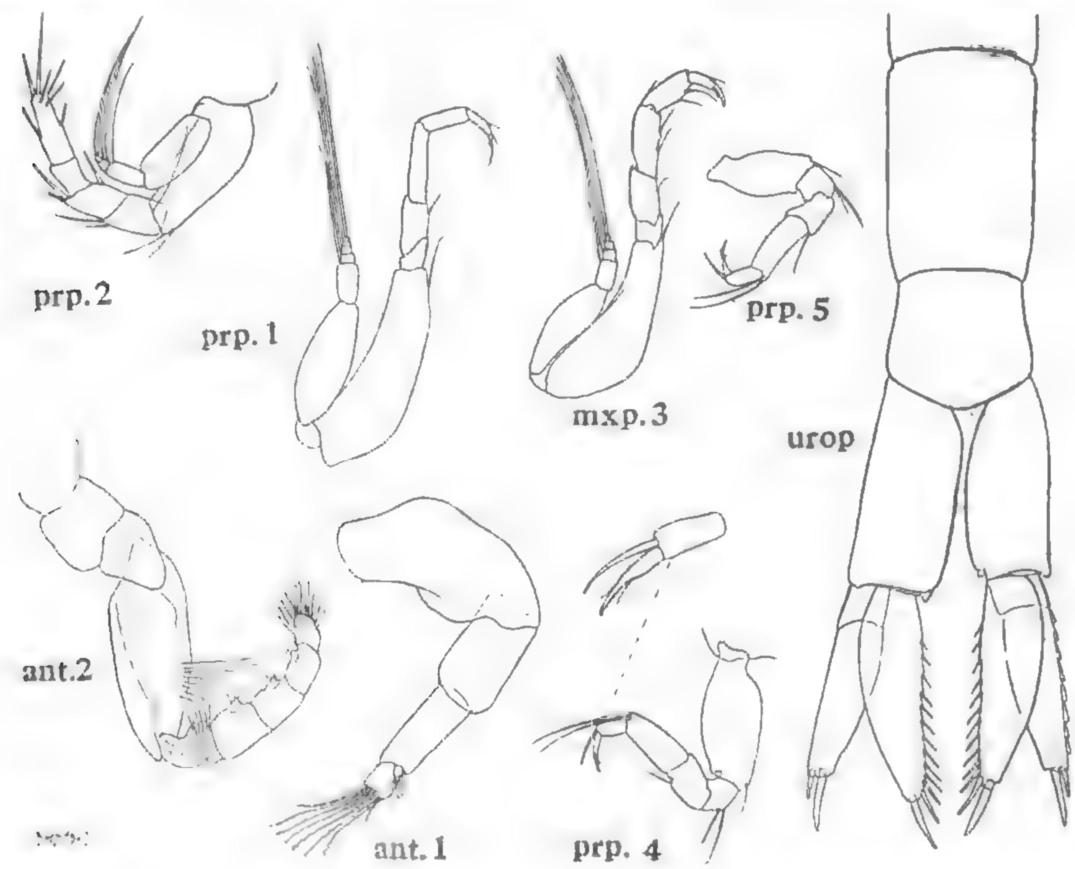

Fig. 23. *Pterocuma poecilota,* adult male; ant., first and second antennae (× 220); prp., peraeopods (× 112; dactylus of fourth × 220); urop., uropod with fifth pleon and telsonic somites (× 112).

Third maxilliped (as in female) scarcely differing from first peraeopod; its basis is a little shorter, but the rest of limb is equal in length to that of first leg, although stouter; carpus longer than merus or propodus, which are subequal in length; exopod stout.

First peraeopod short, its total length barely equal to that of carapace; basis almost as long as remaining joints together; carpus as long as ischium and merus together, the latter longer than propodus.

Second peraeopod with basis shorter than rest of limb, merus a little longer than carpus, and dactylus more than twice as long as propodus; (while the ischium is distinct in the female, I cannot distinguish it in the fully adult male).

Exopod of third peraeopod well-developed, with robust flagellum; basis in third and fourth peraeopods almost half as wide as long, and about equal in length

to ischium, merus and carpus together; in the fifth pair it is shorter. Carpus of fossorial peraeopods as long as ischium and merus together and more than twice as long as propodus with two slender, stiff distal setae, reaching beyond tip of dactylus; propodal seta stout, almost spine-like, reaching to tip of dactylus.

Peduncle of uropod half as long again, and almost as deep, as telsonic somite; very broad, its width nearly half its length, and without armature; rami wide, the endopod a little longer than exopod and as long as peduncle; exopod with two unequal distal spines, the longer nearly one-third as long as the ramus; endopod with a stout distal spine a little more than one-fourth its own length and with a series of a dozen spines on inner face, successively increasing in length backwards (in the female there is normally a row of several spines at distal part of inner edge).

The size of the uropod relative to the peraeopods is shown in fig. 23, where both are drawn to the same scale.

Colour: a broad band of purplish brown across anterior portion of carapace.

Length 1·4 mm.

The adult male is thus smaller than the ovigerous female already described, and also from Tasmania.

Subadult male (Sellick's Beach, South Australia). As the short second antennae are completely concealed beneath the opaque carapace the only external features which distinguish the young male from the juvenile female are the slightly more slender form and the denser sensory filaments of the first antenna. The latter has fewer filaments than in the adult and the peduncular joints are more globose, while the flagellum consists of three joints—if the small terminal element is in reality a true joint; the third peduncular joint bears sensory filaments not discernible in the adult described above.

Adult female, Queensland. Some females with small marsupium, together with an adult male, were taken in Myora Bight, Moreton Bay, by surface netting (I. S. R. Munro, June and Nov., 1940). The females have the carapace less swollen than in the type, but it is tumid on each side towards the front and also over the branchial regions, so that, viewed from above, the lateral margins are sinuate (fig. 22, ceph. ♀). The second pedigerous somite is transversely tumid fore and aft, there being a shallow gutter between the swellings; the third somite is similarly transversely elevated in the posterior half. The uropod is not as robust as in the male and its endopod has usually seven spines on the distal half of the inner margin. The thoracic appendages are as in the southern examples.

Length: females up to 1·9 mm.; male 1–2 mm.

Genus CAMPYLASPIS Sars.

Campylaspis Sars, 1865, p. 200; Stebbing, 1913, p. 187 (syn. and key); Hansen, 1920, p. 36 (discussion of genus).

Stebbing keys twenty-three species. Since then Stephensen (1915, p. 32, fig. 19), Hansen (1920, pp. 38–47, pl. iii–iv), Hart (1930, p. 38, fig. 5, E–I) and Zimmer (1936, p. 427, fig. 35) have described eight new species from the Northern Hemisphere; Foxon (1932, p. 393, fig. 9–10) the single species hitherto recorded from Australia, and the present writer (Hale, 1937a, p. 41, fig. 2–3) one from the Antarctic. Thirteen new species are recorded herein, bringing the total for the genus to forty-six.

Both sexes are known in relatively few of the species but because of the considerable differences in the sculpture of the carapace, a general key, based on that of Stebbing, may be attempted. As the appendages are insufficiently described in some of the species this leaves much to be desired. Hansen stresses the importance of the maxillipeds and first two pairs of peraeopods for systematic pur-

poses. Details of these appendages will become increasingly necessary as further new species are discovered having body sculpture similar to that of one or other of the forms already recorded.

Apart from the proportions of the joints of the second peraeopod, the relative lengths, character, and position—terminal or subterminal—of the distal setae or spines of the dactylus are worthy of notice.

Reference to the figures of the various authors will show that the differences in the third maxilliped are more apparent than would seem to be indicated in the key to the species. The third to fifth peraeopods are of negligible taxonomic interest in this genus, as generally they differ little, while Hansen (1920, p. 44) considers that too much reliance cannot be placed upon the proportions of the uropods and their non-articulated armature.

KEY TO SPECIES OF *CAMPYLASPIS*.

1. Carapace smooth without tubercles, spines, carinae or lateral furrow .. 2.
   Carapace with tubercles, spines or carinae, or at least with a shallow furrow on each side 12.
2. Ocular lobe obsolete .. .. 3.
   Ocular lobe normal .. .. 4.
3. Inner margin of merus of third maxilliped serrate .. .. .. *nitens* Bonnier.
   Inner margin of merus of third maxilliped not serrate .. .. *alba* Hansen.
4. Exopod of uropod a little longer than endopod .. . *pulchella* Sars.
   Exopod of uropod not longer than endopod .. .. 5.
5. Peduncle of uropod three-fourths as long again as endopod .. .. .. 6.
   Peduncle of uropod at least twice as long as endopod .. .. .. 7.
6. Second peraeopod with dactylus shorter than carpus and propodus together .. *glabra* Sars
   Second peraeopod with dactylus longer than carpus and propodus together *paeneglabra* Stebbing.
7. Eye lenses absent .. .. 8.
   Eye lenses present .. .. 9.
8. Carapace with dorsal margin smoothly arched. Uropod of female as long as last three pleon somites together and with peduncle barely more than twice as long as endopod *orientalis* Calman.
   Carapace with dorsal margin slightly uneven. Uropod of female longer, as long as last four pleon somites together and with peduncle distinctly more than twice as long as endopod *pacifica* Sars.
9. Second peraeopod with dactylus longer than carpus and propodus together *rubicunda* Lilljeborg.
   Second peraeopod with dactylus not as long as carpus and propodus together .. 10.
10. Distal segment of second maxilliped with two spines .. .. .. *rufa* Hart.
    Distal segment of second maxilliped with four spines .. .. .. 11.
11. First peraeopod with carpus barely longer than propodus. Uropod of male with peduncle three times as long as endopod .. .. .. *thompsoni* sp. nov.
    First peraeopod with carpus much longer than propodus. Uropod of male with peduncle two and one-fourth times as long as endopod .. .. .. *similis* sp. nov.
12. Carapace with ridges, if present, simple folds, not tuberculate or formed from rows of tubercles or spines .. .. 13.
    Carapace with ridges, if present, tuberculate or formed from rows of tubercules or spines 28.
13. Each side of carapace with a faint furrow which is not margined either above or below by a ridge or fold .. .. 14.
    Each side of carapace with at least one ridge or fold on each side .. .. 15.
14. Dactylus of second peraeopod about as long as carpus, blunt-ended and not tapering *canaliculata* Zimmer.
    Dactylus of second peraeopod longer than carpus, and tapering to the narrow distal end *unisulcata* sp. nov.
15. Carapace with one oblique ridge on each side .. .. 16.
    Carapace with more than one ridge on each side .. .. 17.
16. Peduncle of uropod remarkably broad and only one-third as long again as endopod *platyuropus* Calman.
    Peduncle of uropod slender, three times as long as endopod .. *uniplicata* sp. nov.

17. Carapace of an eroded appearance, with four irregular, subrectangular, depressed areas on each side, bordered by prominent folds .. .. .. *rupta* sp. nov.
Carapace not so sculptured, with carinae on each side subparallel .. .. 18.

18. Two oblique carinae arising anteriorly and extending for greater part of length of carapace on each side .. .. 19.
Three oblique carinae arising anteriorly and extending for greater part of length of carapace on each side .. .. 27.

19. Pseudorostrum unusually long, the lobes meeting for a distance equal to at least one-sixth of length of carapace .. .. 20.
Pseudorostrum much shorter .. .. 21.

20. Ocular lobe obsolete. Peduncle of uropod one third as long again as rami .. *pileus* Foxon.
Ocular lobe small, elongate. Peduncle of uropod more than twice as long as rami *vitrea* Calman.

21. Ocular lobe linguiform, narrow and dilated distally .. .. *macrophthalma* Sars.
Ocular lobe not linguiform, rather broad and not at all dilated distally, or obsolete .. 22.

22. Second peraeopod with dactylus longer than carpus and propodus together .. .. 23.
Second peraeopod with dactylus shorter than carpus and propodus together .. .. 24.

23. Carapace with a transverse dorsal carina behind ocular lobe, uniting the uppermost lateral carinae, and with a short lateral carina, meeting its fellow dorsally near posterior end. Merus of third maxilliped narrow, twice as long as wide .. .. .. *johnstoni* Hale.
Carapace without these carinae. Merus of third maxilliped less than twice as long as wide *sulcata* Sars.

24. Ocular lobe obsolete, without corneal lenses .. .. *ovalis* Stebbing.
Ocular lobe large, with corneal lenses .. .. 25.

25. Dactylus of second peraeopod dilated and rounded at distal end, articulated to which is a short process .. .. *latidactyla* sp. nov.
Dactylus of second peraeopod tapering to the narrow distal end, which bears long setae .. 26.

26. Merus of third maxilliped narrow, about twice as long as wide. Carpus of first peraeopod shorter than propodus .. .. *undata* Sars.
Merus of third maxilliped wide, not much longer than broad. Carpus of first peraeopod longer than propodus .. .. *minor* sp. nov.

27. Lowest of the three lateral keels bifurcate posteriorly. Merus of third maxilliped much shorter than carpus and propodus together .. .. .. *costata* Sars.
Lowest of the three lateral keels not bifurcate. Merus of third maxilliped much longer than carpus and propodus together .. .. .. *triplicata* sp. nov.

28. Carapace with no tuberculate carinae, nor with spines combined in rows on sides to form ridges .. .. 29.
Carapace with tuberculate ridges, or with some of the tubercles combined in rows on sides 41.

29. Carapace not spinose, the sides with a very few low tubercles or with inconspicuous granule-like tubercles .. .. 30.
Carapace spinose, or with many conspicuous tubercles on sides .. .. .. 33.

30. Carapace with tiny granule-like tubercles .. .. 31.
Carapace with a few low dorsal protuberances .. .. 32.

31. Ocular lobe narrow, about twice as long as wide. Distal joint of second maxilliped with three spines. Carpus of third maxilliped large, two-thirds as long as merus *laticarpa* Hansen.
Ocular lobe wider than long. Distal joint of second maxilliped with four spines. Carpus of third maxilliped small, scarcely more than one-third as long as merus .. *roscida* sp. nov.

32. Distal joint of second maxilliped with three spines. Peduncle of uropod smooth *affinis* Sars.
Distal joint of second maxilliped with four spines. Peduncle of uropod serrate *serratipes* Hansen.

33. Tubercles of carapace distinctly spine-like, either robust with acute apices, or slender .. 34.
Tubercles of carapace never slender, but rounded or subconical with blunt apices .. 35.

34. Dorsum of carapace with stout spines. Ocular lobe narrow, not dilated distally. Distal joint of second maxilliped with three spines. Propodus of third maxilliped subequal in length to carpus. Peduncle of uropod not spinose .. .. .. *spinosa* Calman.
Dorsum of carapace with slender spines. Ocular lobe linguiform, dilated distally. Distal joint of second maxilliped with two spines. Peduncle of uropod spinose *echinata* sp. nov.

35. Merus of third maxilliped triangular, expanded distally and as wide as long *frigida* Hansen.
Merus of third maxilliped oblong, never as wide as long .. .. .. 36.

36. Merus of third maxilliped unusually slender, about three times as long as wide *pustulosa* sp. nov.
Merus of third maxilliped not more than twice as long as wide .. .. .. 37.

37. Merus of third maxilliped as long as carpus and propodus together .. .. 38.
Merus of third maxilliped much shorter than carpus and propodus together .. .. 39.

38. Fifth pleon somite with feeble transverse sulcus. First two pedigerous somites elevated dorsally to form pro-curved lamellae .. .. *verrucosa* Sars.
Fifth pleon somite with strongly developed transverse sulcus. First two pedigerous somites not elevated dorsally .. .. *aspera* sp. nov.

39. Pleon somites without dorsal teeth, at most with feeble tubercles on first three somites .. 40.
Pleon somites with dorsal teeth .. .. .. *antarctica* Calman.

40. No depressed area on sides of carapace. Merus of third maxilliped not expanded on inner side. Dactylus of second peraeopod barely as long as carpus .. .. *nodulosa* Sars.
A depressed area on each side of carapace. Merus of third maxilliped triangularly expanded on inner side. Dactylus of second peraeopod longer than carpus .. *globosa* Hansen.

41. Dactylus of second peraeopod almost equal in length to merus, carpus and propodus together, and with a terminal lobe extending beyond insertion of the most distal of the setae .. 42.
Dactylus of second peraeopod at most as long as carpus and propodus together, and with distal setae quite terminal .. .. 43.

42. Pseudorostrum relatively long, the lobes meeting for a distance equal to one-seventh length of carapace. Tubercules of carapace few and large .. .. *rostrata* Calman.
Pseudorostrum shorter, the lobes meeting for a distance equal to one-tenth length of carapace. Tubercles of carapace small and numerous .. .. *thetidis* sp. nov.

43. Merus of third maxilliped more than half as long again as carpus .. .. 44.
Merus of third maxilliped much less than half as long again as carpus *maculata* Zimmer.

44. Sides of carapace with three distinct folds, the uppermost two of which bear large rounded tubercles .. .. *intermedia* Hansen.
Sides of carapace without carinae but the depression bordered with rows of large conical tubercles .. .. 45.

45. Outer margin of merus of third maxilliped strongly dentate .. *horridioides* Stephensen.
Outer margin of merus of third maxilliped not dentate .. .. *horrida* Sars.

CAMPYLASPIS THOMPSONI sp. nov.

Ovigerous female. Integument strongly calcified with the small reticulate patterning somewhat diffuse.

Carapace sparsely clothed with short hairs, without sculpture except for a very fine median line, and with pellucid spots on anterior portion; strongly vaulted above, ovoid in shape as seen from above, with greatest width nearly two-thirds its length, and equal to its depth; it is more than one-half the total length of the animal. Antennal notch and angle barely indicated. Pseudorostral lobes subtruncate in front and meeting for a distance about equal in length to ocular lobe which is as wide as long, subtriangular, barely at all constricted at base, and with three corneal lenses, the median, at anterior end, divided into two.

Pedigerous somites not elevated dorsally and pleural portions not prominent; first two almost wholly concealed.

Marsupium not visible from the side, the ova (0·275 mm. in greatest diameter) completely concealed beneath the bulging carapace.

Pleon somites with faint indications of dorso-lateral carinae; fifth without transverse sulcus; telsonic somite rounded distally and very little produced.

Second and third peduncular joints of first antenna subequal in length, each less than two-thirds as long as first; first segment of flagellum twice as long as second.

First maxilliped with terminal joint minute, with one tiny seta; a score of gill-leaflets plus one reflexed.

Terminal joint of second maxilliped with four falcate spines; the outermost small and crowded, the longest reaching to about level of tip of distal spine of penultimate joint.

Third maxilliped with basis wide and short, not quite as long as remaining joints together; merus two thirds as wide as long, as long as carpus, propodus and dactylus together, and with margins serrate, but with no outstanding dentation

although two small subdistal teeth on outer edge are rather prominent; carpus wider than propodus, but equal to it in length, with half a dozen teeth on inner margin and with two outer spines crowded together; propodus twice as long as dactylus and with three or four teeth on inner edge at proximal fourth.

First peraeopod with basis about as long as rest of limb; merus three-fourths as long again as carpus which is subequal to propodus and twice as long as dactylus.

Second peraeopod longer than first, with basis as long as ischium, merus and carpus together; dactylus subequal in length to carpus, with terminal setae insignificant.

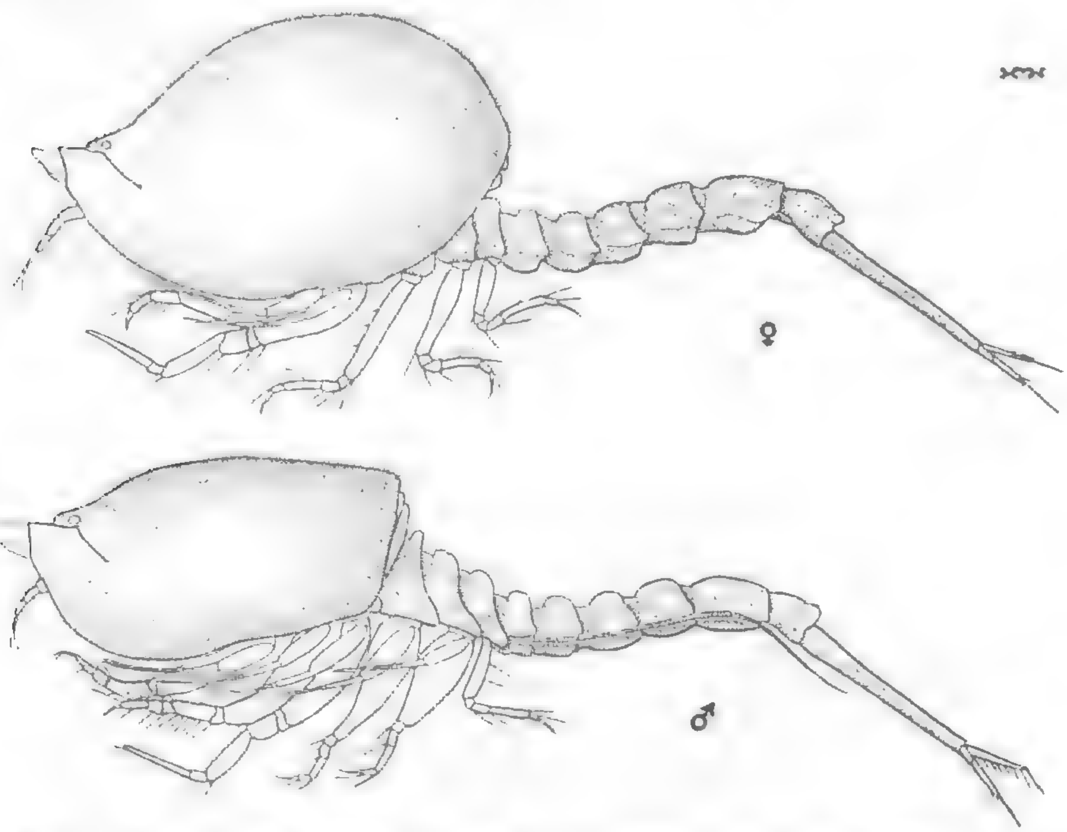

Fig. 24. *Campylaspis thompsoni*, types adult female and male from the side (× 19).

Peduncle of uropoda long and slender, three times as long as telsonic somite, three and one-half times as long as endopod and with inner edge serrate; endopod barely longer than exopod, with three spines on inner margin and two very unequal terminal spines, the longer more than half length of ramus; exopod with longest terminal spine equal in length to second joint.

Colour white.

Length 4·5 mm.

Adult male. Carapace less than half of total length of animal; its width is three-fifths its length and greater than its depth. Antennal notch even more completely obliterated than in female. Ocular lobe slightly larger, and rather more constricted at base; three corneal lenses.

Pedigerous somites three to five a little elevated dorsally and with pleural portions expanded and rounded.

Last joint of peduncle of second antenna more than twice as long as penultimate joint.

In the uropod the endopod is one-fourth as long again as the exopod and has seven spines, as well as minute spinules, on inner margin; peduncle three times as long as telsonic somite, and also as endopod, with plumose setae on inner edge.

Length 4·5 mm.

Loc. Tasmania: off Babel Island, lat. 39° 55′ S., long. 148° 31′ E. (type loc., "Warreen" Station 29, Jan., 1939). New South Wales: 4 miles off Pt. Hacking, 80 metres on mud (K. Sheard, trawled, May, 1944). Types in South Australian Museum, Reg. No. C. 2342–2343.

The New South Wales locality is based upon a single male which, though adult, is only 3·5 mm. in total length; in detail, however, it agrees closely with

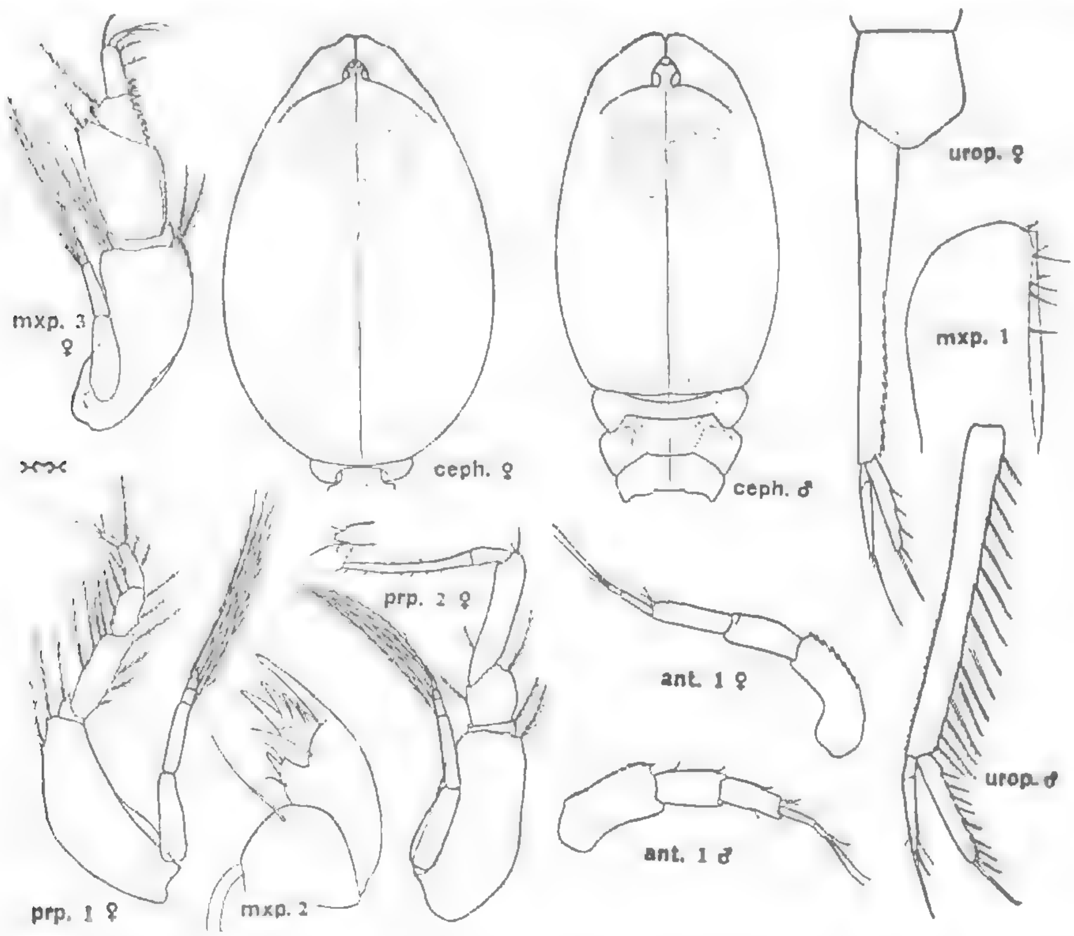

Fig. 25. *Campylaspis thompsoni*, ceph., cephalothorax of types female and male from above (× 19). Paratype female and male; mxp. 1–2, distal portions of first and second maxillipeds (× 90); ant., mxp. 3, prp. and urop., first antenna, third maxilliped, peraeopods and uropods (× 34).

the males from further south, the uropods being identical in the armature and length of peduncle, while the thoracic appendages exhibit no differences in the proportions of the joints.

C. pacifica Sars (1887, p. 66, pl. x, fig. 6) from the Philippines appears to be related but differs in the shape of the carapace, with wavy dorsal outline, the absence of corneal lenses, the well-defined antennal notch, the more exposed pedigerous somites, etc. The uneven dorsal contour of the carapace and the distinct antennal notch are both mentioned and figured by Sars, but information regarding the appendages is scanty.

Stebbing, in his key to the genus (1913, p. 188) separates his *paeneglabra* from allied species in that it has the carapace less than one-half the total length. *C. paeneglabra* was described from the male only and in the species described above the male differs from the female in this respect.

C. thompsoni resembles quite closely *glabra* Sars and *paeneglabra* Stebbing. In the last-named, however, the male eye-lobe shows no lenses, the dactylus of the second peraeopods is longer than the carpus and propodus together, the rami of the uropoda are relatively much longer, etc.

C. glaba has the rami of the uropoda proportionately considerably longer, the first two pedigerous somites well produced dorsally and not almost wholly concealed in the female, while the basis of the second peraeopod, according to Sars' figure, is relatively shorter.

This species is named after Dr. Harold Thompson, the Chief of the Fisheries Division of the Council for Scientific and Industrial Research.

CAMPYLASPIS SIMILIS sp. nov.

Adult male. Closely resembling the mature male of *thompsoni*.

First maxilliped with terminal joint minute, but distinct with a single seta; about a score of gill lamellae.

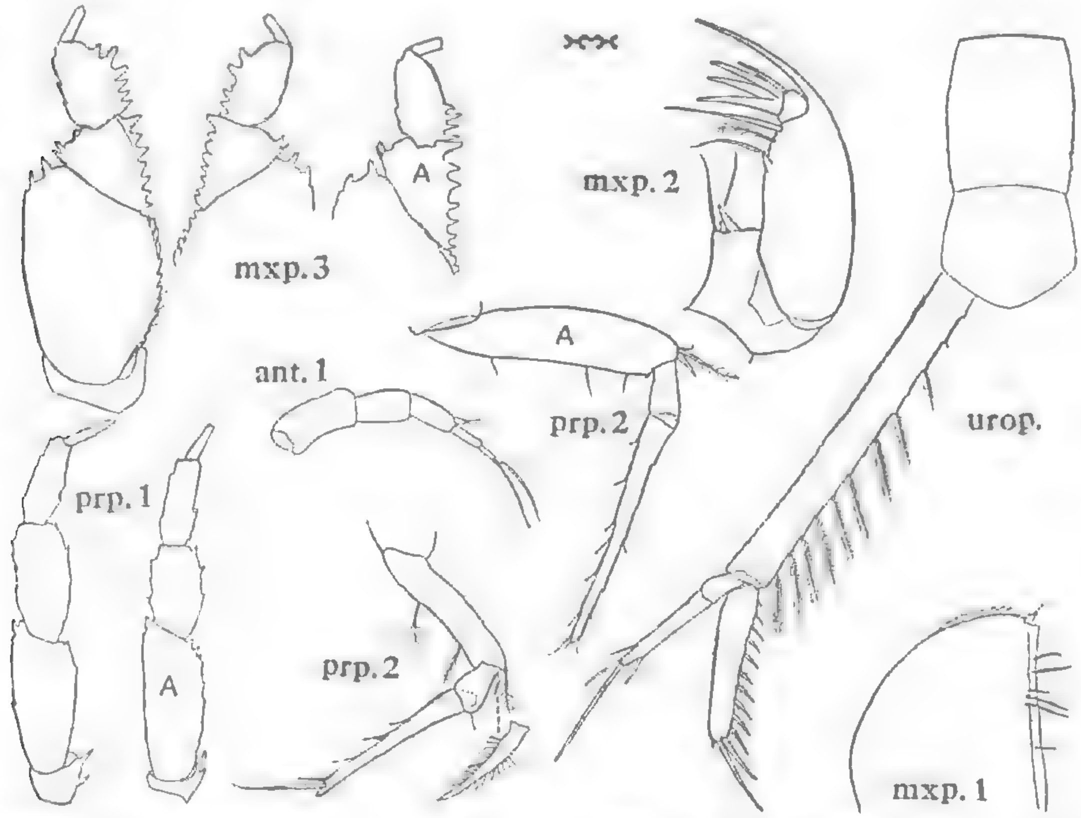

Fig. 26. *Campylaspis similis*, type male; ant. 1, first antenna (× 60); mxp. 1–2, terminal joints of first and second maxillipeds (× 114); mxp. 3 and prp., distal joints of third maxilliped, and first and second peraeopods (× 60); urop., uropod with fifth pleon and telsonic somites (× 42). A, Distal joints of third maxilliped, and first and second peraeopods, of adult male of *C. thompsoni* (× 60).
Plumose setae omitted on third maxillipeds and first peraeopods.

Distal joint of second maxilliped with four spines; the outermost shorter and much more slender than the others, which are subequal in length; outer distal spine of penultimate joint slender, curving well beyond the terminal spines; opposite this at inner margin is a very stout distal seta followed by a plumose and a plain slender seta.

Third maxilliped much as in *thompsoni* but a little broader and with inner edge of propodus serrate for greater part of length.

First peracopod with merus only one-third as long again as carpus, which is much longer than propodus and twice as long as dactylus.

Dactylus of second peraeopod almost as long as carpus and propodus together, and with longest terminal seta half as long as the joint.

Peduncle of uropod three times as long as the short, broad and little produced telsonic somite, but only two and one-fourth times as long as endopod; with spaced plumose setae on inner margin; endopod with three terminal spines, the outermost very small, and with nine or ten spines on inner margin; exopod a little shorter than endopod with the longest of its two terminal spines fully as long as its second joint.

Colour white.

Length 3·8 mm.

Loc. Tasmania: off Babel Island, lat. 39° 55′ S., long. 148° 31′ E. ("Warreen" Station 29, Jan., 1939). Type in South Australian Museum, Reg. No. C. 2566.

C. similis may be separated from *thompsoni* without dissection by the different proportions of the joints of the first peraeopod and by the shorter peduncle of the uropod.

CAMPYLASPIS UNISULCATA sp. nov.

Adult male. Integument calcified and brittle, with reticulate pattern small, rather diffuse on carapace and of somewhat imbricate appearance on pleon.

Carapace with obscure, very fine median dorsal line; smooth on sides excepting for a single longitudinal, faint, slightly curved furrow running from neighbourhood of antennal notch to about four-fifths of the length; depressed and with dorsal margin little arched; fully twice as long as deep, and distinctly less than half

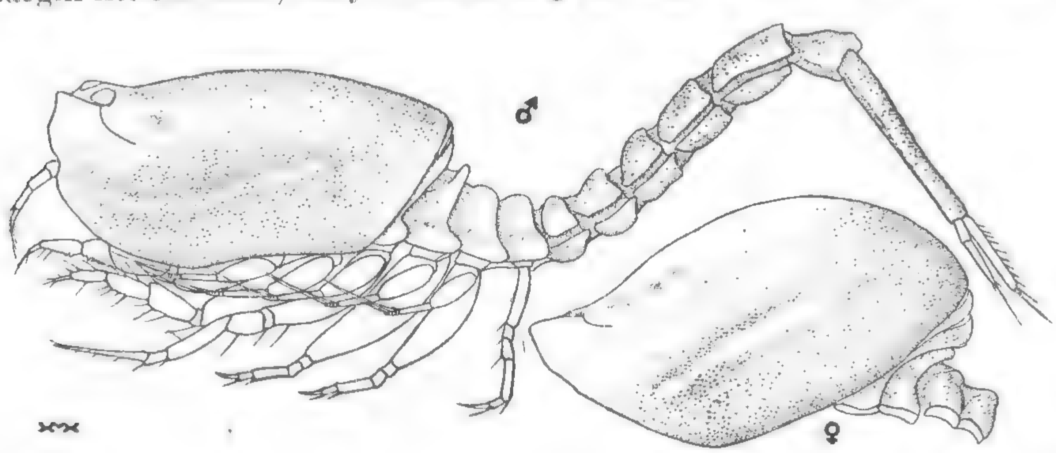

Fig. 27. *Campylaspis unisulcata,* type male and cephalothorax of paratype female (× 23).

the total length of animal; viewed from above it is suboval in shape with the anterolateral areas below the lateral groove prominent, while the sides are not quite evenly curved but slightly sinuate. Antennal notch shallow, smoothly concave; below it the margin is rounded, not at all angular. Pseudorostral lobes subtruncate and slightly concave in front, meeting for a distance equal to about half length of ocular lobe, which is rounded, large, rather wider than long and with three prominent lenses arranged in a triangle, the hinder ones situated at and beyond the postero-lateral parts of the lobe.

First pedigerous somite concealed excepting for a narrow dorsal strip; it and the second elevated dorsally and with anterior margin as seen from above slightly produced forwards and angular medianly; third a little elevated posteriorly on the back; fourth and fifth somites with a pair of low longitudinal dorsal ridges; pleural parts of second to fifth rounded, not much expanded backwards.

Pleon with very fine dorsal longitudinal line on fifth and telsonic somites; fifth without transverse sulcus; telsonic somite as wide as long, rounded posteriorly, but scarcely at all produced, and only about as long as wide.

First peduncular joint of first antenna longer than third, which is longer than second; flagellum with terminal (second) joint much shorter than first and with a brush of sensory setae.

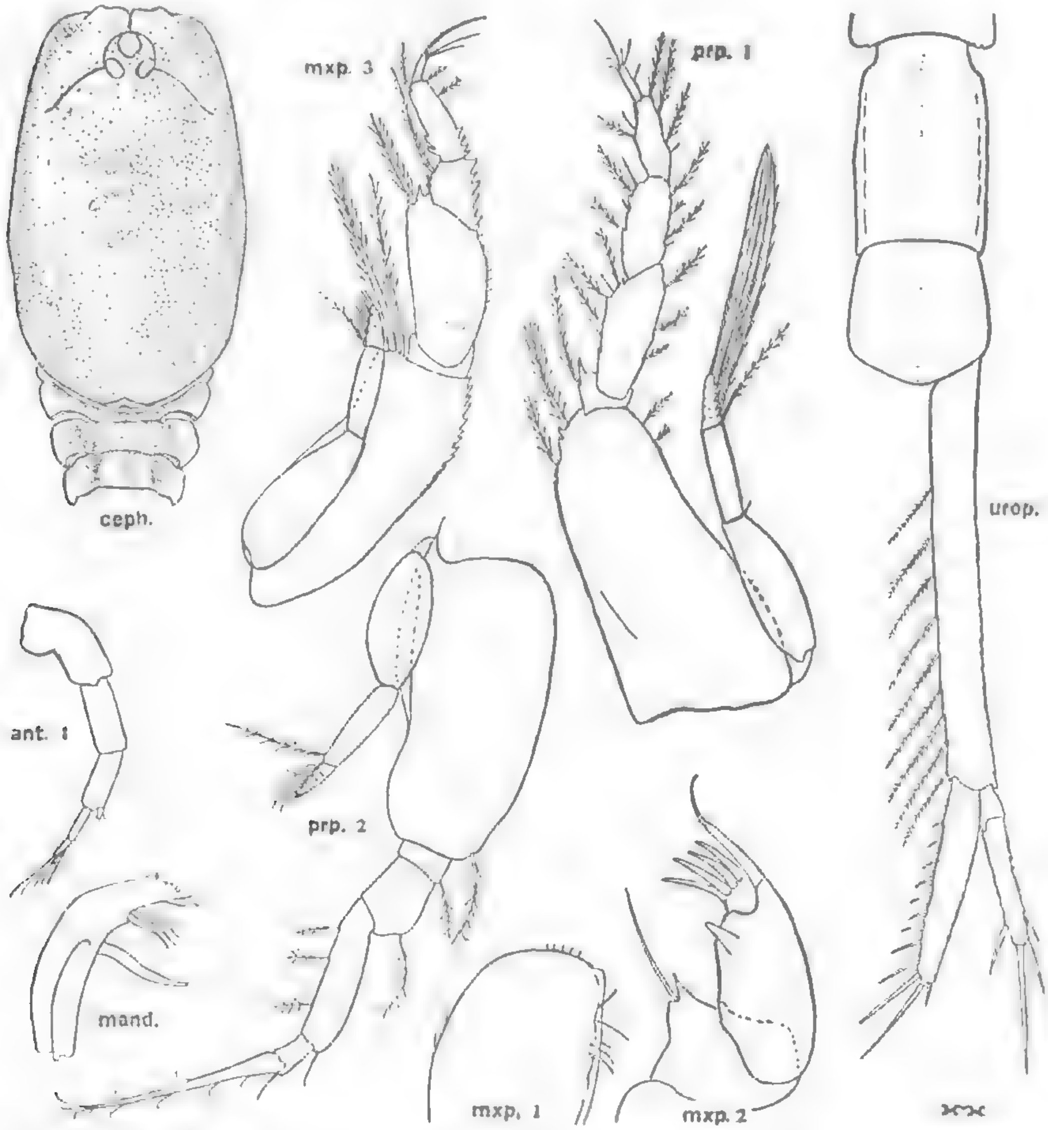

Fig. 28. *Campylaspis unisulcata*, type male; ceph., cephalothorax from above (× 23); ant. and mand., first antenna and mandible (× 70); mxp. 1–2, distal portions of first and second maxillipeds (× 130); mxp. 3 and prp., third maxilliped and peraeopods (× 60); urop., uropod with fifth pleon and telsonic somites (× 60).

Second antenna with last segment of peduncle fully twice as long as penultimate.

Mandible with three stout spines in the row and with the slender molar process almost half as long as the incisor part distal to it.

First maxilliped with terminal joint so minute that it is difficult to discern.

Terminal joint of second maxilliped with four spines, subequal in length, each about half as long as distal outer spine of penultimate joint; the last named spine is slender and flexible distally.

Third maxilliped stout; basis serrate on distal part of inner edge and almost as long as rest of limb; merus fully twice as long as wide, almost as long as carpus, propodus and dactylus together, with inner margin crenulate and outer with two subdistal spines, in between which is the usual plumose seta; carpus coarsely serrate on inner edge and with a pair of small teeth on outer margin; propodus three times as long as dactylus and about one-fifth longer than carpus, with about four inner teeth close together and two outer teeth, all in proximal half.

First peraeopod with the wide basis subequal in length to rest of limb; ischium with a strong inner tooth, rest of joints not regularly serrate; merus about one-third as long again as carpus; propodus not much shorter than carpus and twice as long as dactylus.

Second peraeopod longer than first, with the wide basis longer than ischium to propodus together; dactylus markedly tapering, as long as carpus and propodus together, and with terminal setae short and slender.

Peduncle of uropod with insignificant serrations on outer margin and nine setae (with short plumes) on inner margin, it is three times as long as telsonic somite and slightly more than twice as long as endopod; exopod four-fifths as long as endopod, with longest of two terminal spines as long as its second joint, with a subdistal inner spine and two, slender, on the outside edge; endopod with ten inner spines (type as in *rupta*, *thompsoni*, etc.) successively increasing in length, the last five times longer than first; longest of the two very unequal terminal spines of endopod only half as long as ramus.

Colour, white, tinged with brown at anterior end of carapace.

Length 3·9 mm.

Subadult female. A single example with uropods abnormal, has the carapace well-arched above and not depressed as in the male; it is not quite twice as long as deep and is a little more than half the total length of animal; it bulges backwards to the rear but does not overhang the dorsum of the pedigerous somites.

Length 3·6 mm.

Loc. South Australia: St. Vincent Gulf, Rapid Bay, 4 fath., on mud (type loc., H. Cooper, E. J. Hanka and A. Rau, Jan., 1944). Tasmania: off Babel Island, lat. 39° 55′ S., long. 148° 31′ E. ("Warreen" Station 29, Jan., 1939). Type, male, in South Australian Museum, Reg. No. C. 2562.

This species shares with the Californian *canaliculata* Zimmer 1936, p. 427, fig. 35) the distinction of possessing a depression on the side of the smooth carapace not margined by folds. The maxillipeds are very similar in Zimmer's species although the terminal joint of the first pair is less rudimentary; the dactylus of the second peraeopod, however, is dilated apically and bears no terminal setae, whereas in *unisulcata* this joint is longer, tapers to a rather unusual degree, and has terminal setae. The joints of the first peraeopods are also of different proportions; in *canaliculata* the "carpus and propodus are of nearly equal length", and are so shown in Zimmer's fig. 35 j, but in *unisulcata* the carpus is distinctly longer than propodus.

CAMPYLASPIS UNIPLICATA sp. nov.

Female. Integument calcified, brittle and fragile; very short setae over whole of body.

Carapace with a single rounded carina on each side, running from the neighbourhood of the antennal notch obliquely upwards and terminating at second third of length just before reaching the mid-line of the back; lower and parallel to this ridge is a feeble longitudinal gutter but no distinct second ridge; a low, double, antero-lateral tumidity on each side and an insignificant median longitudinal line on back, otherwise smooth except for the very fine reticulation and faint wavy, oblique striae; there are a few elongate pellucid spots, arranged in a trans-

verse row, at first fourth of length; back, as seen from the side, sinuate and rising steeply to about first third of length, thence evenly and strongly arched; seen from above the width is two-thirds the length and the pseudorostrum is irregular laterally, thence the sides are evenly curved; the total length of the carapace is less than that of the pleon. Pseudorostral lobes oblique, pointed in front and meeting for a distance greater than length of eye-lobe, which is roundly subtriangular, as wide as long, with three corneal lenses, the apical lens divided into two. Antennal notch a shallow concavity and angle widely rounded.

Pedigerous somites scarcely elevated dorsally, the second to fifth with pleural parts globose and rounded posteriorly.

Pleon somites with no definite sculpture, save for two or three eroded areas on each side of first to fifth; telsonic somite as wide as long, a little widened posteriorly, rounded distally and not much produced.

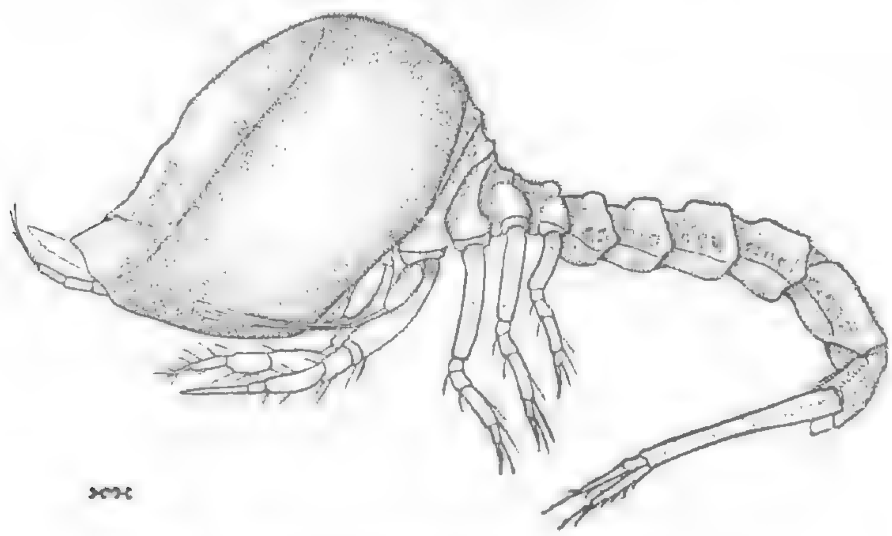

Fig. 29. *Campylaspis uniplicata*, type female (× 21).

Second and third peduncular joints of first antenna subequal in length, each not much longer than first and shorter than the slender flagellum, the first segment of which is longer than the second.

Second antenna single-jointed. Upper lip rather long.

First maxilliped with terminal joint elongate, minute, with a single seta; twenty-one gill-lobes on epipod.

Last joint of second maxilliped with four spines, three subequal, the fourth shorter and more slender; penultimate joint with two distal setae and with the outer spine stout and reaching beyond tips of dactylar spines.

Third maxilliped with basis very short, only as long as ischium, merus and carpus together; merus large, nearly twice as long as wide, a little longer than carpus and propodus together and with three outer teeth near distal end; carpus as wide as long, three-fourths as long as propodus and with small denticles on short outer edge.

First peraeopod without definite dentition; basis much shorter than rest of limb; merus one-third as long again as carpus, which is longer than propodus.

Second peraeopod a little longer than first; basis short, as long as ischium to propodus together; dactylus a little longer than carpus with insignificant setae as in *thompsoni*.

Peduncle of uropod long slender, serrate on inner margin, almost three times as long as telsonic somite, and three times as long as rami, which are subequal in

length; endopod with four composite spines on inner edge and two unequal terminal spines, the longer three-fourths as long as the ramus; exopod with one inner spine and with the longer of the two terminal spines longer than the second joint, and than that of endopod.

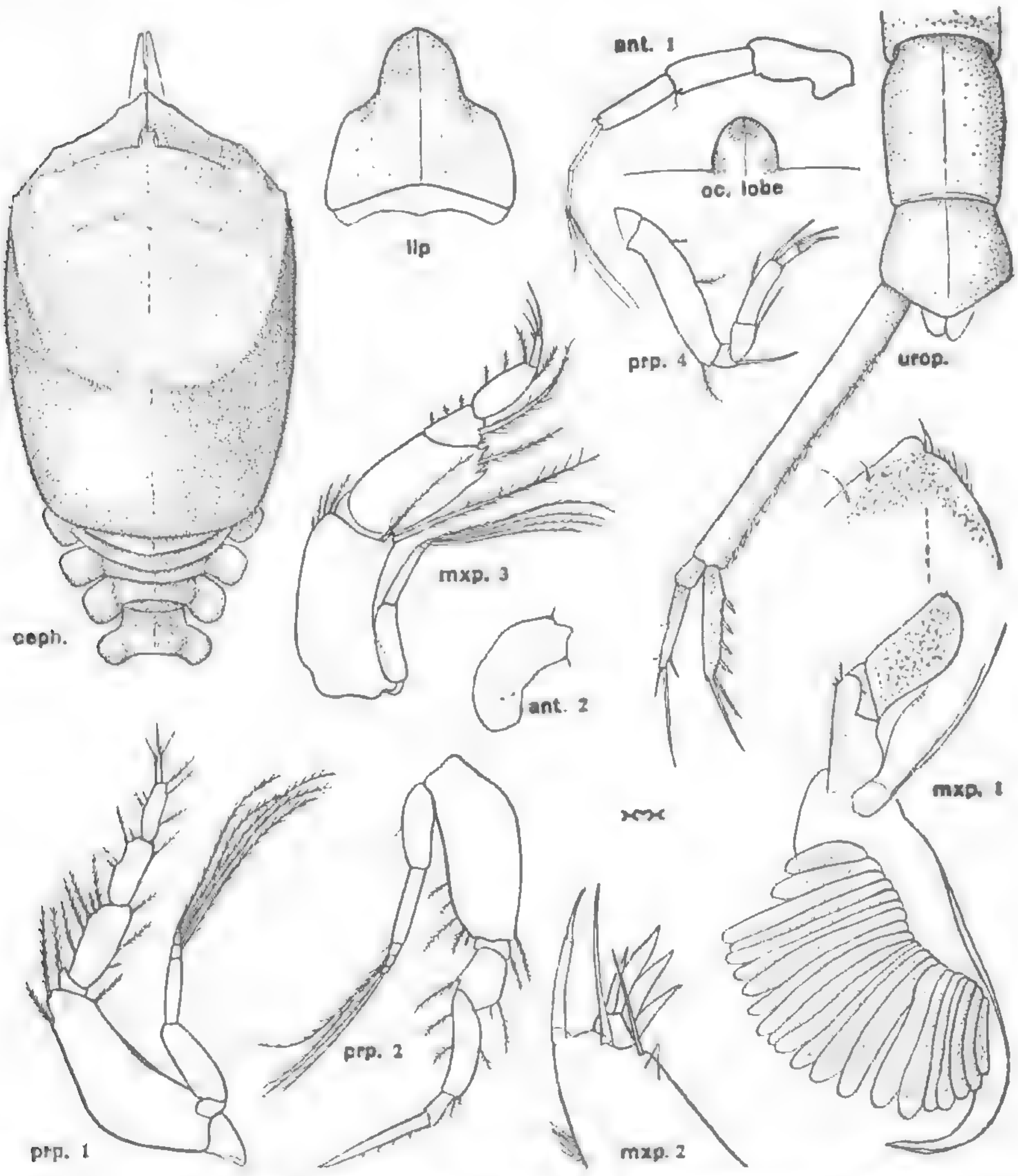

Fig. 30. *Campylaspis uniplicata*, type female; ceph., cephalothorax from above (× 22); oc. lobe, lip and ant., ocular lobe, upper lip and antennae (× 62); mxp., first to third maxillipeds (× 32; distal portions of first and second × 144); prp., peraeopods (× 32); urop., uropod with fifth pleon and telsonic semites (× 32).

Colour milk white without trace of pigment.

Length 4·8 mm.

Loc. New South Wales: 5 miles east of Port Hacking, 100 metres, on mud (type loc., "Cronulla" Trawl Station, July, 1943); 4 miles east of Port Hacking, 80 metres, on mud (K. Sheard, trawled, May, 1944). Type in South Australian Museum, Reg. No. C. 2522.

A smaller female, 3·1 mm. in total length, has the dorsum of the first and second

pedigerous somites almost perpendicular as seen from the side and not even slightly elevated; the appendages, etc., are as in the type.

Apart from *platyuropus* Calman (1911, p. 364, pl. xxxiv, fig. 25–29), this is the only known unicarinate member of the genus.

Campylaspis rupta sp. nov.

Adult male. Integument not strongly calcified, not brittle but tough and not easily torn.

Carapace with strong sculpture, consisting of shallow depressions with tumid edges; the largest excavation is lateral, above it are two dorso-lateral depressions in posterior half; anterior to it is an excavation behind the antennal area and immediately above it is a small hollow (fig. 31), the mid-line is ridged and irregular, so

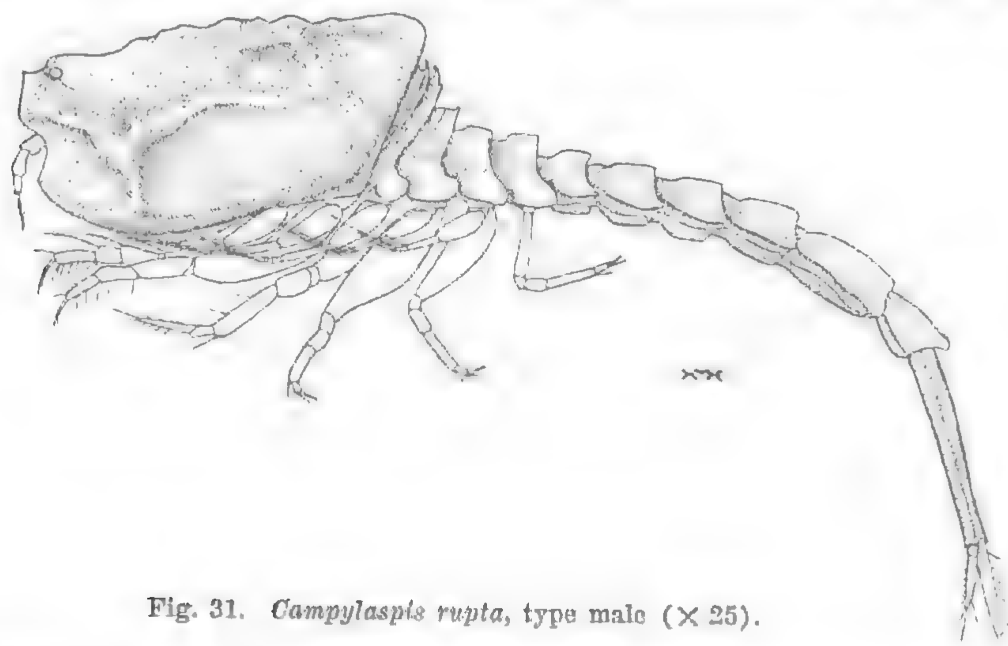

Fig. 31. *Campylaspis rupta*, type male (× 25).

that seen from the side the dorsal contour is markedly uneven, slightly arched and somewhat concave at base of ocular lobe; viewed from above it is widest in posterior third but is considerably broadened anteriorly owing to a large tumidity at the upper anterior part of the largest lateral depression; it is two-fifths of the total length of the animal, depressed and twice as long as deep. Antennal notch widely open and angle obtuse. Ocular lobe rounded, wider than long with three distinct corneal lenses arranged in a triangle and a further conjoined pair, less distinct, on each side.

First to third pedigerous somites each with a transverse carina, medianly sharply elevated and with a pair of small tubercles; fourth and fifth somites each with a pair of longitudinal dorsal carinae.

Pleon narrow; first four somites each with a pair of dorsal carinae as in posterior pedigerous somites. Fifth somite slightly constricted at two-thirds of length as seen from above but with no transverse sulcus; from the side no constriction is apparent but there is a slight ventral indentation at this point; this somite has a median longitudinal carina, most distinct on posterior half; telsonic somite produced more than usual in genus, with apex rather narrowly rounded, and with median carina; it is much longer than wide.

First joint of peduncle of first antenna as long as second and third segments together; flagellum two-jointed, as long as third peduncular joint and shorter than second.

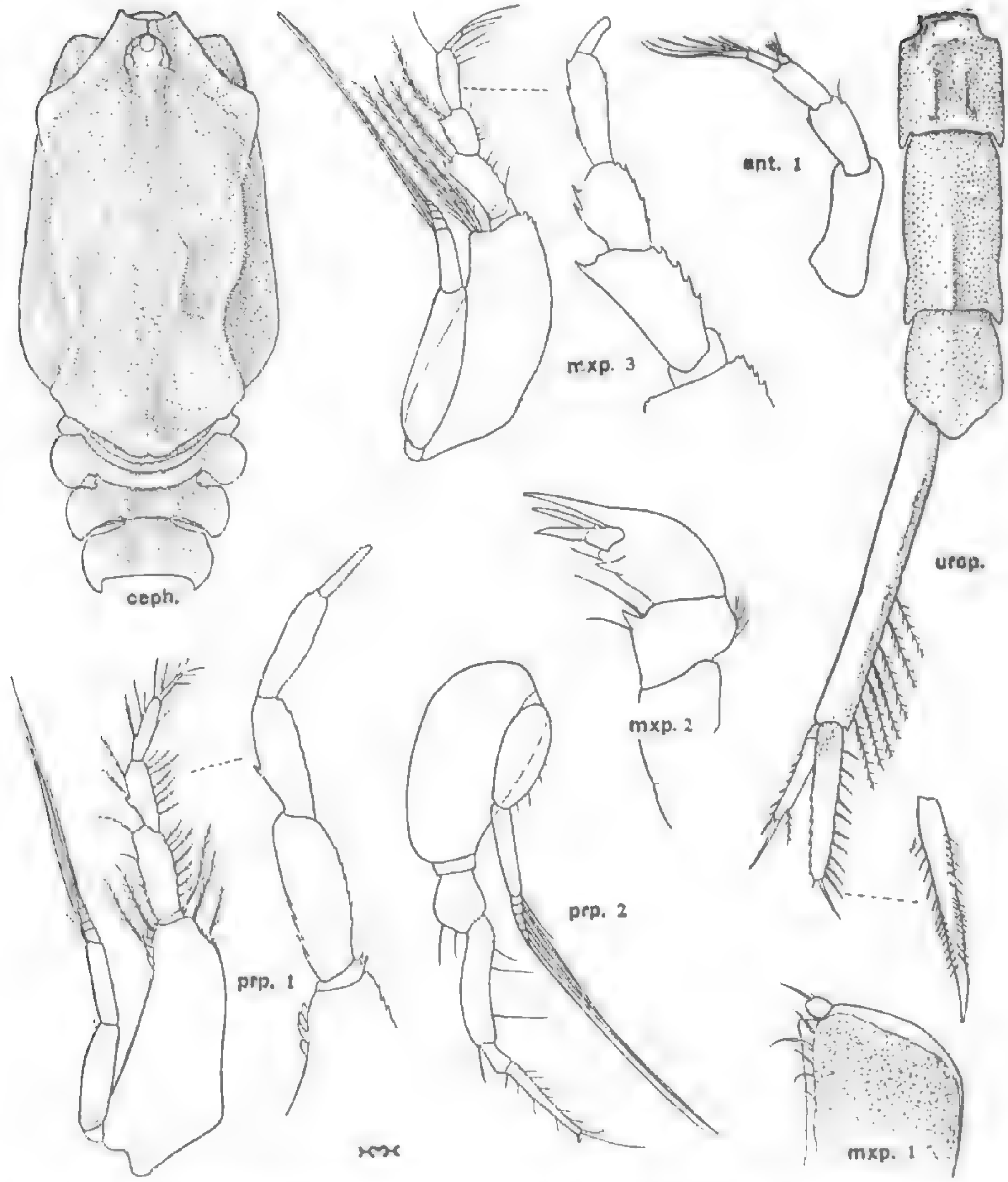

Fig. 32. *Campylaspis rupta.* ceph., Cephalothorax of type male from above (× 272). Paratype male; ant. 1, first antenna (× 100); mxp. 1–2, distal portions of first and second maxillipeds (× 140); mxp. 3, and prp., third maxilliped and peraeopods (× 50; distal portions with plumose setae omitted, × 100); urop., uropod with fifth pleon and telsonic somites (× 50).

Second antenna with last segment of peduncle one and three-fourths times as long as penultimate.

First maxilliped with terminal joint small, only about one-sixteenth of length of penultimate, globose and capped with a seta longer than itself and a minute seta.

Distal joint of second maxilliped with two spines, one slightly longer than the other and not reaching quite to tip of outer spine of penultimate joint.

Third maxilliped with basis stout and longer than rest of limb; merus widest distally, less than twice as long as wide, much shorter than carpus and propodus

together, with a prominent subdistal outer tooth and with inner margin serrate, carpus wider than, and five-sixths as long as, propodus, with inner margin serrate and with two teeth on outer edge; dactylus much less than half as long as propodus.

First peraeopod with rather prominent closed serrations at distal end of outer margin of basis, which is as long as the rest of the limb; ischium with two small inner teeth; merus much longer than carpus and with both margins partly serrate; carpus little longer than propodus, with a tooth at middle of length of outer margin; dactylus more than half as long as propodus.

Second peraeopod a little shorter than first, with the stout basis as long as ischium to propodus together; dactylus little more than three-fourths as long as carpus and much longer than its longest terminal seta.

Peduncle of uropod carinate, as long as fifth pleon and telsonic somites together, twice as long as endopod, and with plumose setae on distal half of feebly serrate inner margin; endopod half as long again as exopod, with two very unequal terminal spines and an inner row of ten, all compound (see fig. 32, urop.); exopod with row of spines on outer edge, two unequal terminal spines and a single plumose seta on inner margin.

Colour, yellow, generously mottled with dark brown on thorax, pleon and all exposed appendages. No attempt is made to show the patterning in fig. 31, as this would confuse the sculpturing.

Length 4 mm.

Loc. South Australia: St. Vincent Gulf, Brighton, off jetty, 1-2 fath. (Misses Pat. Mawson and L. M. Angel, and K. Sheard, submarine light, Oct., 1941). Type in South Australian Museum, Reg. No. C. 2560.

The bold sculpture is distinctive. Most if not all of the other Australian species of *Campylaspis* were taken on mud, the type of bottom which would be expected for the genus, but *rupta* was on clean white sand; there are, however, patches of silt here and there in the Gulf and only two males of this species were secured by the collectors.

CAMPYLASPIS LATIDACTYLA sp. nov.

Non-ovigerous female. Integument well calcified, coarsely pitted-reticulate on carapace; granulate on pedigerous and pleon somites, and on basal joints of peraeopods and uropods.

Carapace with a single deep, wide curved furrow on each side, margined above and below with a low fold; broad, a little wider than deep, fully half as long again as depth, and less than half of total length of animal; dorsally it is moderately arched and does not at all overhang the pedigerous somites posteriorly; seen from above it is broadest across the lower of the lateral folds, which are well-separated on the back. Antennal notch and angle obsolete. Pseudorostral lobes truncate anteriorly, meeting for a distance equal to length of ocular lobe, which is rounded, wider than long, and has three corneal lenses.

Pedigerous somites all exposed and, like carapace, with a fine median carina; together they are not much more than two-fifths as long as carapace; dorsally each is tumid, but not produced; pleural portions globose, not produced backwards.

Fifth pleon somite without transverse sulcus, barely longer than wide, and little longer than telsonic somite, which is dilated laterally towards the distal end, is wider than long and has the hinder margin broadly rounded and scarcely produced.

First joint of peduncle of first antenna nearly half as long again as second which is longer than third.

Terminal joint of second maxilliped with three spines, subequal in length, but one much more slender than the others; penultimate joint with outer distal spine

long, reaching for one-third of its length beyond dactylar spines and with distal part tapering and flexible; this joint also bears two subdistal spines as well as the usual triangular tooth and a strong seta.

Third maxilliped almost as long as first peraeopod; basis as long as merus, carpus and propodus together; merus nearly twice as long as wide, longer than carpus plus propodus, and with no armature save a couple of feeble subdistal outer teeth; propodus one-fourth as long again as carpus and barely twice as long as dactylus.

First peraeopod with basis two-thirds as long as rest of limb; merus half as long again as carpus, which is equal in length to propodus and less than twice as long as dactylus.

Second peraeopod longer than first, with basis stout and not much longer than merus and carpus together; ischium indistinct; dactylus a little longer than carpus and distinctive in structure, being dilated distally, with a single short clavate, articulated process (evidently a modified seta) inserted near the terminal end (see fig 34, dactylus).

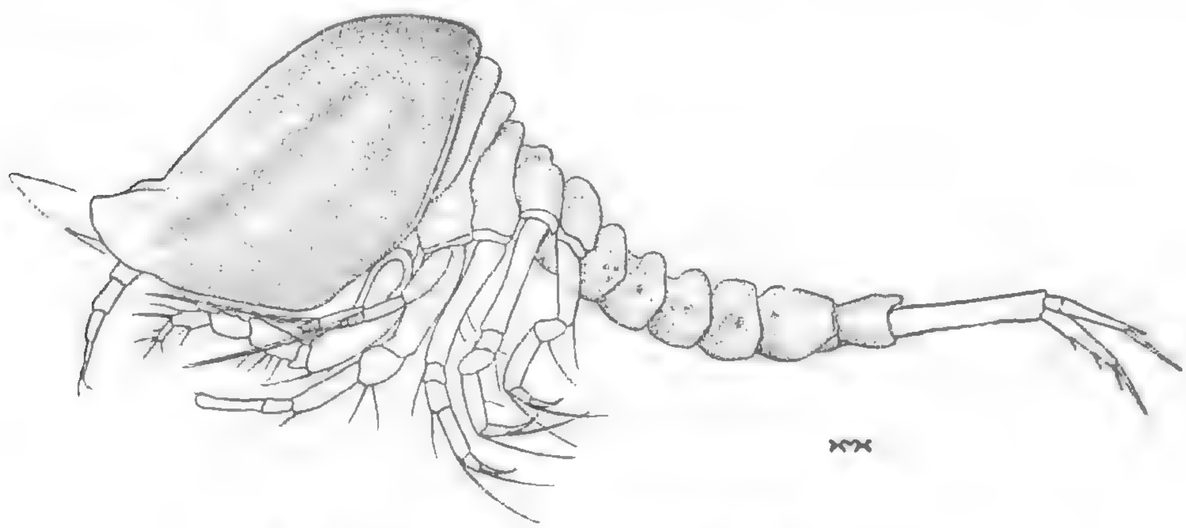

Fig. 33. *Campylaspis latidactyla*, type female (× 40).

Third to fifth peraeopods with the carpal seta and propodal seta long, each reaching very much beyond tip of dactylus.

Peduncle of uropod serrate on inner edge, more than twice as long as telsonic somite and not quite twice as long as endopod, which is equal in length to the exopod; endopod with two spines on inner margin and two distal spines, one of which is more than twice as long as the other and fully two-thirds as long as the ramus; longer of the two very unequal terminal spines of exopod as long as second joint of the ramus.

Colour, white with numerous dark ocelli on carapace and pedigerous somites, and a few on anterior pleon somites and basis joints of peraeopods.

Length 2·2 mm.

Loc. Queensland: Moreton Bay, Myora Bight, surface (I. S. R. Munro, Stations 45 and 55 [type loc.], 50 cm. 40 m. net, 10.30 p.m. on Nov. 29, 1940 and 9.40 p.m. on Dec. 6, 1940). Type in South Australian Museum, Reg. No. C. 2618.

A female was taken at each station; the paratype is 2–6 mm. in length and differs from the type in having three inner spines on endopod of uropod and in having more of the first pedigerous somite concealed beneath the carapace, which is granulate instead of pitted.

Amongst the Australian species with a single furrow on the side of the carapace this species stands apart by the curious dactylus of the second leg; there is a similar modification in *canaliculata* Zimmer (1936, p. 427, fig. 35) but there the subterminal seta is slender and plumose while the fainter longitudinal sulcus of the carapace, and the dorsally well produced first and second pedigerous somites serve readily to separate it.

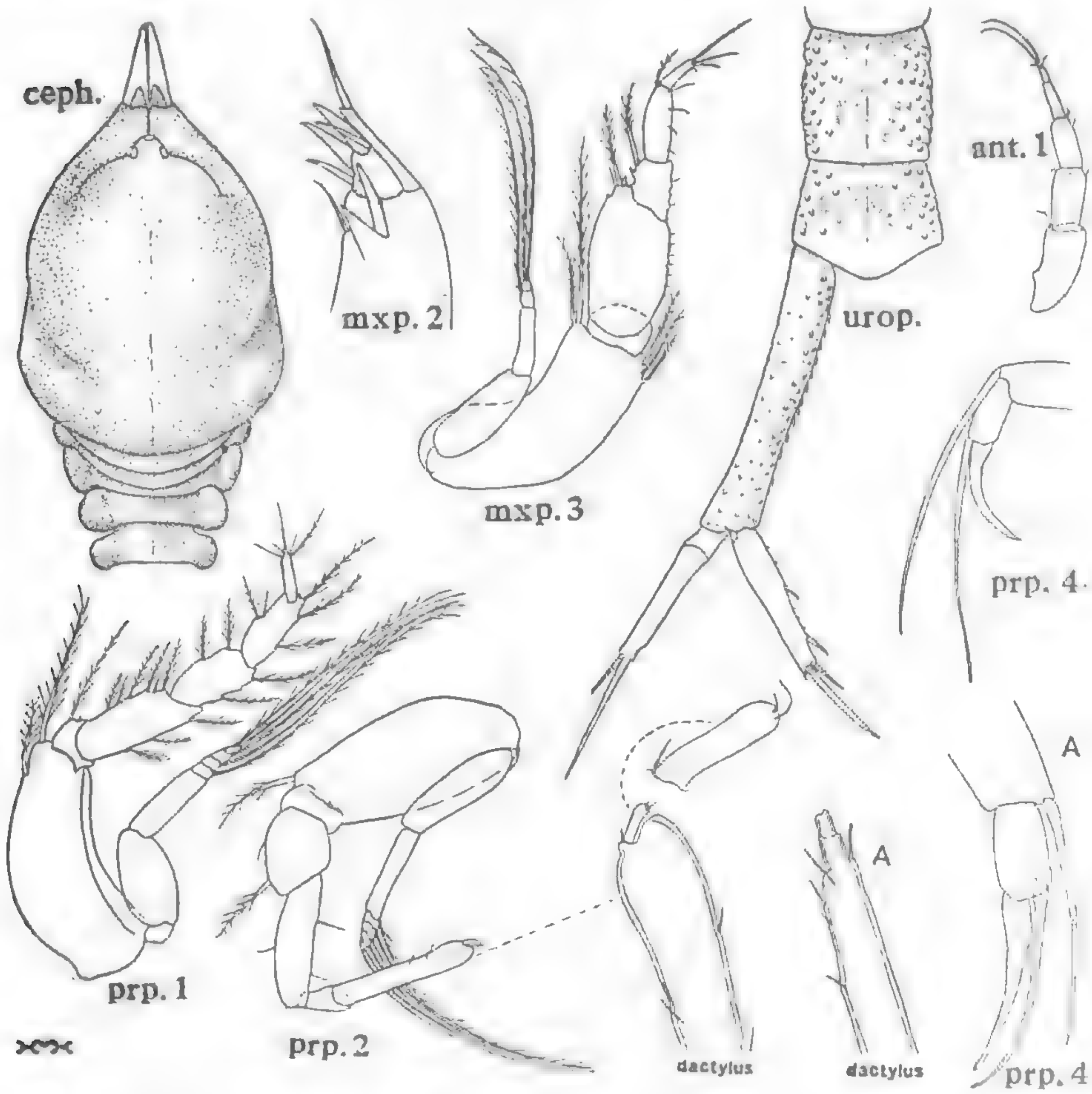

Fig. 34. *Campylaspis latidactyla*, type female; ceph., cephalothorax from above (× 39); ant. 1, first antenna (× 77); mxp. 2, distal portion of second maxilliped (× 240); mxp. 3 and prp., third maxilliped, and first and second peraeopods (× 77); dactylus, distal half of dactylus of second peraeopod (× 240; terminal "seta", × 720); prp. 4, distal portions of fourth peraeopod (× 126); urop., uropod with fifth pleon and telsonic somites (× 77). A, *Campylaspis uniplicata*; distal half of dactylus of second peraeopod (× 240); distal joints of fourth peraeopod (× 126).

The dactylus of the second leg of *uniplicata* sp. nov. while tapering to the apex and not at all dilated, bears a truncate terminal process instead of slender setae (cf. fig. 34, A); this species has the lateral furrow very faint but has an upper carina which extends further back than in *latidactyla*, has short fossorial setae on the posterior legs, etc.

CAMPYLASPIS MINOR sp. nov.

Ovigerous female. Integument somewhat rugose, with faint reticulate patterning.

Carapace with a well-marked, curved, lateral impression on the side, margined above and below by a low fold; the folds are widely separated on the back; dorsal margin strongly arched and bulging; it is less than twice as long as deep, about as wide as long, and is half the total length of the animal; viewed from above it is ovoid in shape (the lateral impressions noticeably affecting the outline) and the antero-lateral margins slope backwards very obliquely from the pseudorostrum. Antennal notch and angle obsolete. Pseudorostral lobes somewhat pointed in front

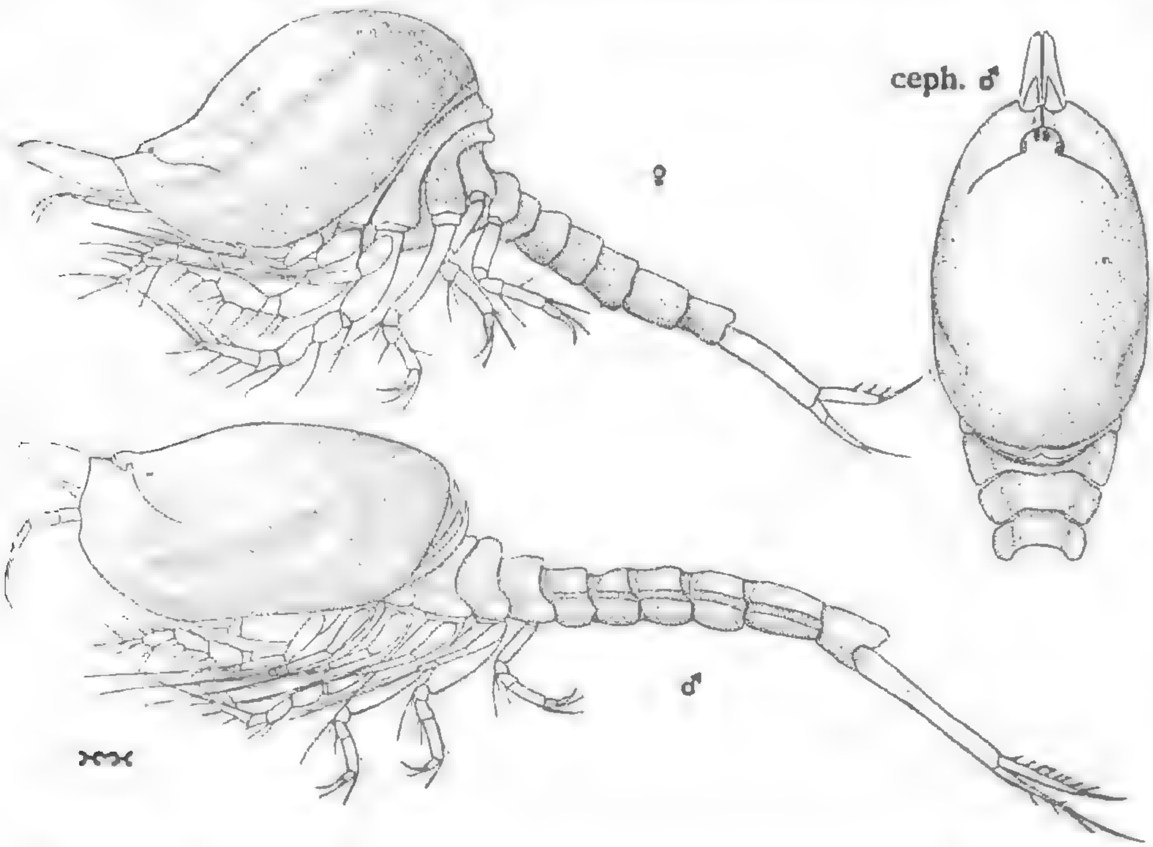

Fig. 35. *Campylaspis minor*; lateral view of type ovigerous female (× 60); lateral view and (ceph.) dorsal view of cephalothorax of paratype male (× 40).

as seen from the side as well as from above, meeting for a distance equal to length of ocular lobe. There are three pale lenses in the ocular lobe, which is rounded and as wide as long.

First pedigerous somite exposed as a narrow strip; posterior half of dorsum of second and third elevated transversely, the tumidity rounded and not at all prominent; pleural portions of somites swollen, but not much expanded backwards; together these somites are little more than one-third as long as carapace.

Pleon two-thirds as long as carapace, the somites short and stout; telsonic somite rounded posteriorly, much wider than long and not much shorter than the fifth, which has no transverse sulcus and is fully as wide as long.

First antenna slender; third peduncular joint nearly one-third as long again as second, but shorter than first. Second antenna two-jointed, not much longer than first joint of peduncle of first pair.

Terminal joint of second maxilliped with four long spines, three subequal in length, one a little shorter, none reaching level of apex of distal outer spine of penultimate joint.

Third maxilliped wide and large, equal in length to the first peraeopod; basis about four-fifths as long as rest of limb; merus widest distally (where its breadth is not very much less than its length) and not quite as long as carpus and propodus together; carpus a little shorter than propodus, with three blunt inner teeth; propodus more than twice as long as the short dactylus, with three rounded teeth on inner side near proximal end.

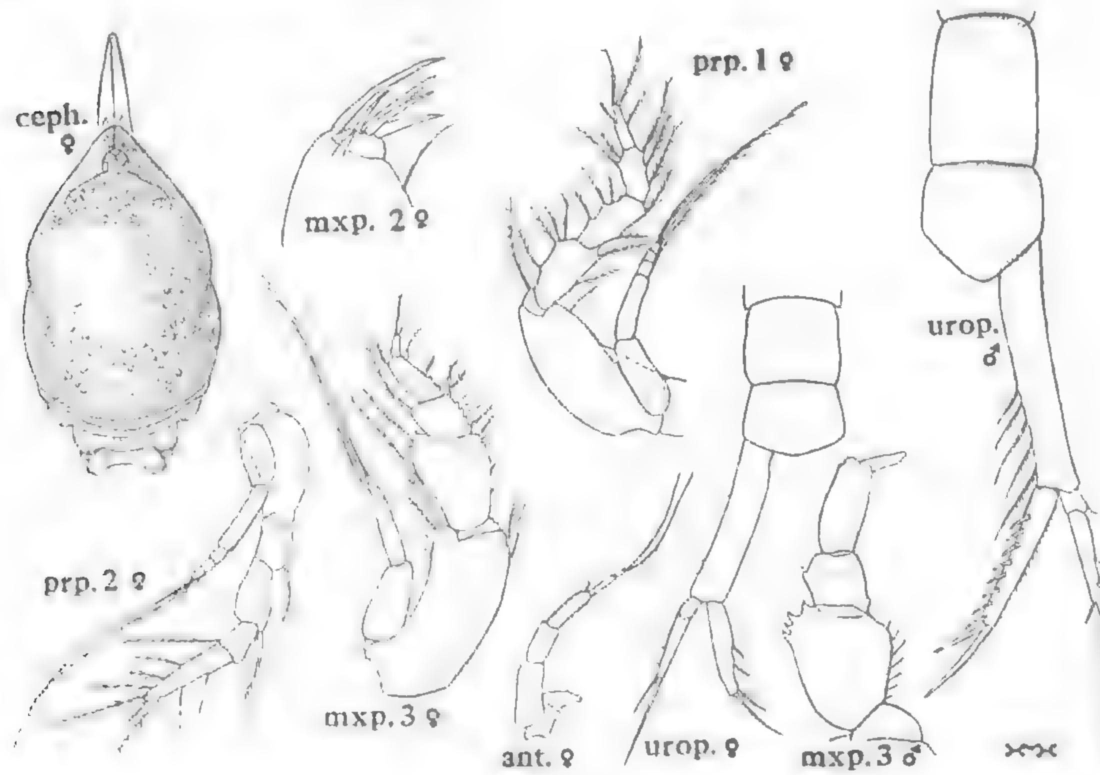

Fig. 36. *Campylaspis minor.* Type ovigerous female; ceph., cephalothorax from above (× 37); ant., first and second antennae (× 80); mxp. 2, distal portion of second maxilliped (× 230); mxp. 3 and prp., third maxilliped and peraeopods (× 80); urop., uropod with fifth pleon and telsonic somites (× 80). Paratype male; mxp. 3, distal portion of third maxilliped, with plumose setae omitted (× 105); urop., uropod with fifth pleon and telsonic somites (× 80).

First peraeopod with basis considerably shorter than rest of limb; merus a little longer than carpus; propodus shorter than carpus and not much longer than dactylus.

Second peraeopod not quite as long as first, with basis short, less than half as long as rest of limb; ischium fairly distinct; dactylus stout, tapering to distal end, much longer than carpus but shorter than carpus plus propodus, and with long plumose setae, the longest terminal one longer than the joint.

Fossorial setae of posterior peraeopods short, not reaching beyond apex of dactylus.

Peduncle of uropod fully twice as long as telsonic somite and less than twice as long as endopod; exopod almost as long as endopod, with one of the two unequal distal spines as long as the ramus; endopod with two spines on inner margin and two unequal terminal spines, the longer of which is about three-fourths as long as the ramus.

Colour, yellow, the carapace with a few isolated brown spots, one near postero-lateral corner, one near end of pseudorostral suture, and one over branchial region on each side, also a pair of dorsal spots near hind margin; basis of third and fourth peraeopods with a brown spot.

Length 1·2 mm. Ova 0·19 mm. in greatest diameter. Other females 1·4 mm.

Adult male. Carapace slightly depressed, almost twice as long as deep, less than half total length of animal, and with dorsal margin scarcely arched; lateral furrow distinct. Pseudorostral lobes subtruncate in front.

First and second pedigerous somites elevated and curving slightly forwards on the back, medianly angular; pleural portions of first concealed, of second to fifth swollen and slightly produced backwards; dorsum of third to fifth somites somewhat tumid.

Pleon as long as carapace; telsonic somite rather angularly rounded posteriorly, as long as wide, produced over bases of uropods, and distinctly shorter than fifth somite, which is wider at posterior end than it is anteriorly, and is nearly half as long again as wide.

Second maxilliped as in female. Third maxilliped with merus rather more robust, and distinctly shorter than carpus and propodus together.

Peraeopods, except for larger basis, of same proportions as in female; longest terminal seta of dactylus of second peraeopod as long as propodus and dactylus together.

Peduncle of uropod fully twice as long as telsonic somite and less than twice as long as endopod, with several setae, increasing successively in length, on distal half of inner margin; exopod shorter than endopod, with the longest of its two unequal terminal spines longer than the whole ramus; endopod with a row of seven spines on inner margin and with the longer distal spine two-thirds as long as ramus.

Colour as in female.

Length 1·9 mm. Other adult males 1·5 mm. to 1·7 mm.

Loc. Queensland: Moreton Bay, Myora Bight, surface (I. S. R. Munro, Stations 28, 29, 44 [type loc.] and 46, 50 cm. 40 m. net, 2.30 a.m., 3.30 a.m., 9.30 p.m. and 11.30 p.m., Nov. 29, 1940), and in shallow water over coral patch (I. S. R. Munro, Station 55, 50 cm. 40 m. net, 9.40 p.m., Dec. 6, 1940); Noosa River, below Gympie Terrace, surface (I. S. R. Munro, Station T.44.1, 50 cm. 40 m. net, 9.12 p.m., Mar. 25, 1944). Type in South Australian Museum, Reg No. C. 2620.

The tiny type female has a patch of granules on the back of the carapace in the posteror half but these are absent in the other specimens. In the male the spines on the inner margin of the endopod of the uropod vary in number from seven to nine, but the setae of the peduncle of this appendage are restricted to distal half. The small series of adults exhibit a rather unusual range in size but the appendages of all are too alike to admit the probability of more than one species.

In general, *minor* rather closely resembles *unisulcata*, but apart from the much smaller size is distinguished by the markedly more distinct lateral impression on the carapace, the proportions of the joints of the third maxilliped and first and second peraeopods, and the shorter uropod; further, the plumose dactylar setae of the second leg are very long whereas in *unisulcata* they are insignificant.

The peraeopods are remarkably like those of *triplicata* but that species is at once separated by the three lateral carinae, while the carapace of the male is more arched, the third maxilliped is distinctive, etc.

The carapace of the female has the lateral furrow much as in that of *latidactyla*, which has very different peraeopods; it is, however, more boldly arched dorsally, as in *glabra* and *thompsoni*, but does not project backwards over the free pedigerous somites as in the two last-named species.

CAMPYLASPIS TRIPLICATA sp. nov.

Adult male. Integument calcified brittle. Carapace with an upwardly curved depression on each side, bordered above and below by a fine ridge, and not reaching to mid-line of dorsum, below this and subparallel to the lower margin of carapace is a similar third ridge; above the lateral hollow the sides are tumid, then fall into a second faint elongate depression not emphasized by ridges. and above this again is a further still fainter furrow; the dorsal margin is moderately arched, not quite evenly curved but slightly rugose, and does not form a marked angle near ocular lobe; viewed from above it is ovoid in shape, narrowest in front; it is less than one-half the length of the animal, slightly depressed and nearly twice as long as deep. Antennal notch distinct, widely open, and angle rounded and a little obtuse. Pseudorostral lobes subtruncate in front and meeting for a distance slightly greater than length of ocular lobe; respiratory tubes unusually long. Ocular lobe large, semicircular, wider than long, and with three large white corneal lenses.

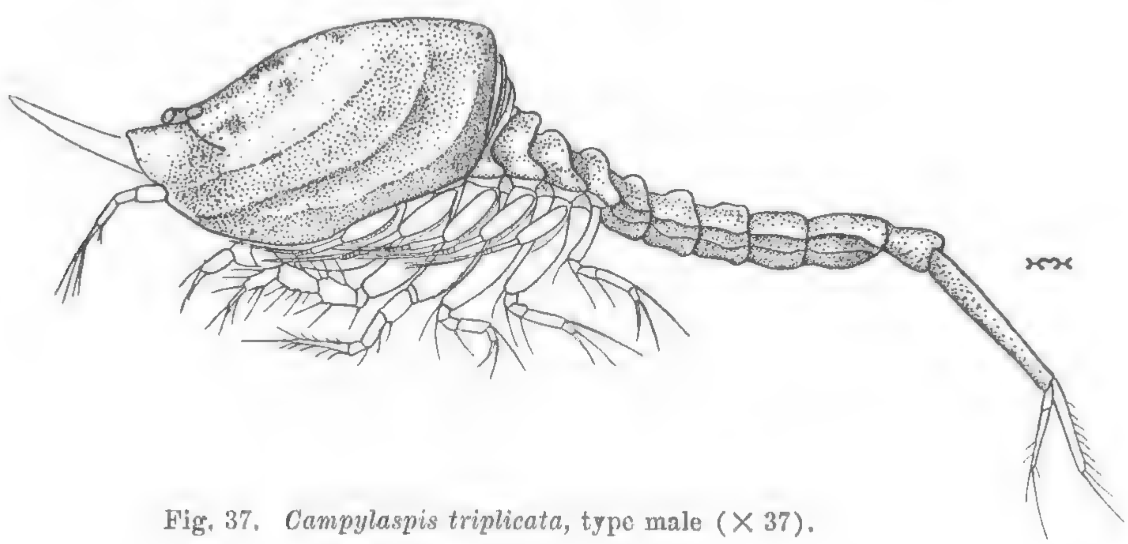

Fig. 37. *Campylaspis triplicata*, type male (× 37).

First pedigerous somite largely concealed; dorsal margin of first and second sloping obliquely backwards, not at all elevated; dorsum of third to fifth tumid but not markedly so; pleural parts of second to fifth only moderately expanded not much produced backwards.

Pleon somites (like pedigerous) smooth; no sulcus on fifth somite; telsonic somite widest posteriorly where it is fully as wide as long, and with apex angularly rounded.

Third maxilliped stout, with basis much shorter than rest of limb; merus rather wide (its greatest breadth a little more than half the length) longer than carpus, propodus and dactylus together, with two teeth towards distal end of outer margin; carpus much wider but a little shorter than propodus, with four curved teeth on outer edge and three less sharply defined on inner.

First peraeopod with basis shorter than rest of limb; remaining joints with margins irregular but without teeth; merus, carpus and propodus subequal in length (merus longer than carpus, which is longer than propodus); dactylus relatively long, five-sixths as long as propodus.

Second peraeopod about equal in length to first, with basis almost as long as remaining joints together; dactylus much longer than merus or carpus, which

are subequal in length; merus and carpus together as long as propodus and dactylus together; longest terminal seta of dactylus fully as long as the latter.

Peduncle of uropod with setae, successively increasing in length, on whole length of inner margin; it is long, nearly three times length of telsonic somite and almost twice as long as endopod, which is one-fifth as long again as exopod; there are seven "serrate" spines, successively increasing in length, on inner margin of endopod and two terminal spines, one of which is a little longer than the other

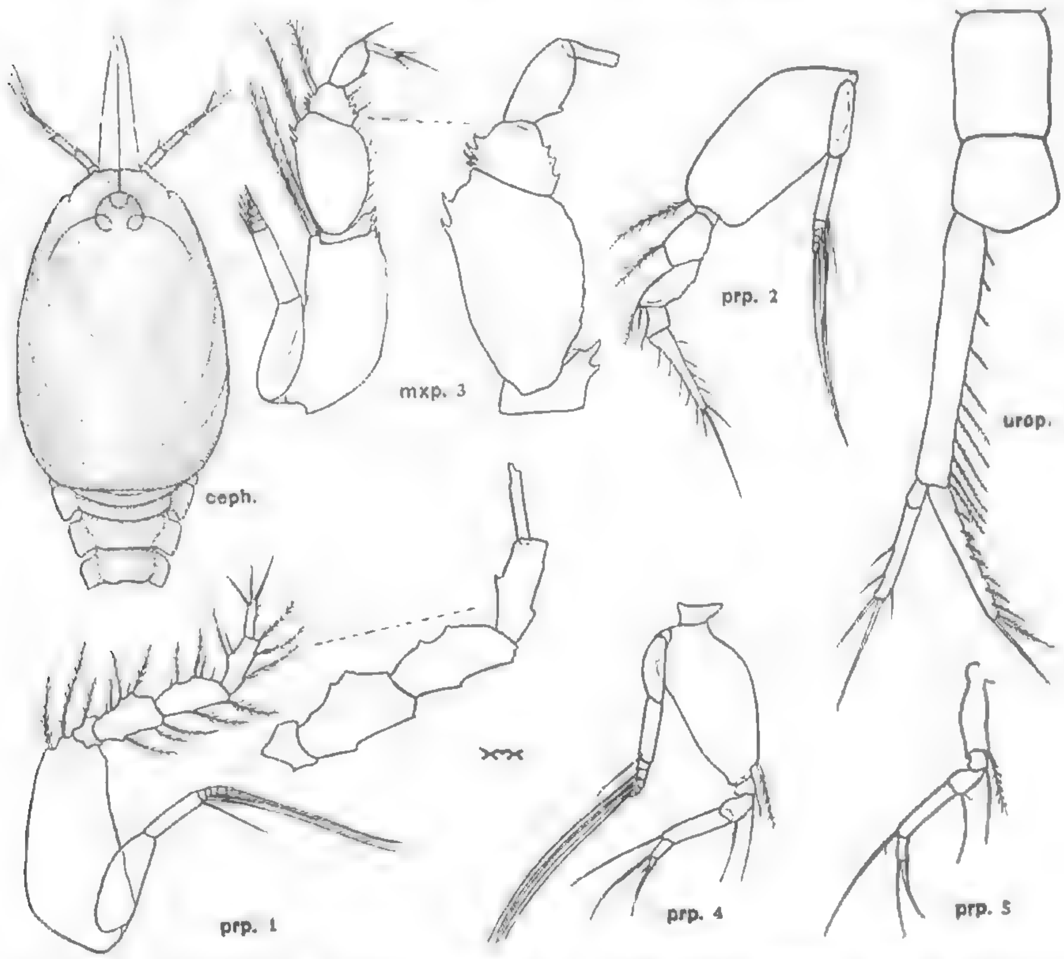

Fig. 38. *Campylaspis triplicata,* type male; ceph., cephalothorax from above (× 34); mxp. 3, prp. and urop., third maxilliped, peraeopods and uropod with fifth pleon and telsonic somites (× 54; distal portions of maxilliped and first peraeopod, with plumose setae omitted, × 90).

and more than half the length of the ramus; the marginal spines are interspersed with minute spinules; exopod with longest of two apical spines as long as itself and with two setae on outer margin and one, subdistal, on inner.

Colour, white.

Length, 2·3 mm.

Loc. Queensland: off Moreton Island (type loc., "Warreen" Station, May, 1939); Moreton Bay, Myora Bight, surface (I. S. R. Munro, Station 46, 50 cm., 40 m. net, 11.30 p.m., Nov. 29, 1940); Noosa River, below Gympie Terrace, and level with Gympie Terrace, surface (I. S. R. Munro, Stations T.44.1–2, 50 cm., 40 m. net, 9.12 p.m. and 9.28 p.m., Mar. 25, 1944). Type in South Australian Museum, Reg. No. C. 2582.

The female is unknown but the adult males range from 1·9 mm. to 2·4 mm. in length. All examples have been preserved in formalin.

The only other species of the genus possessing three ridges on each side is the Northern *costata* Sars (1900, p. 87, pl. lx), which differs in having the hindermost carina bifurcate and the third maxillipeds considerably different.

Campylaspis roscida sp. nov.

Ovigerous female. Integument thin, calcified, brittle, scarcely at all flexible.

Carapace with short sparse hairs and a few pellucid spots; generally smooth, but with feeble antero-lateral tumidities and with very small glassy tubercles anteriorly and dorso-laterally, so that it appears as if sprinkled with tiny dewdrops; boldly vaulted dorsally and oval when viewed from above; with greatest width less than depth and less than two-thirds its length; it is a little less than half total length of animal. Antennal notch slight, but distinct; angle rounded.

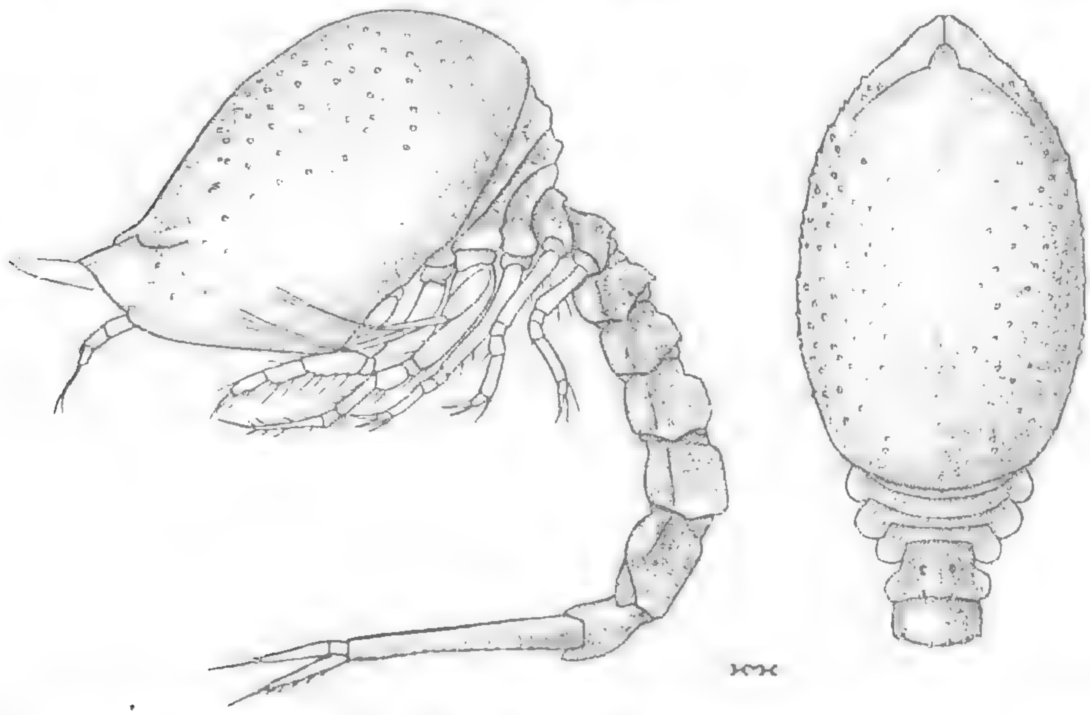

Fig. 39. *Campylaspis roscida*, lateral view and dorsal view of cephalothorax of type female (× 27).

Pseudorostral lobes oblique in front, meeting for a distance equal to length of ocular lobe which is not pigmented, is roundly subtriangular and not constricted at base; corneal lenses not distinct but an oval opaque area at each lateral corner and at apex.

Pedigerous somites sprinkled with obsolete granules particularly laterally, with fine median line as on carapace; first and second somites exposed, slightly and angularly elevated dorsally; pleural portions of first to third expanded and globose; fourth less expanded laterally with a pair of dorsal pits and a pair of tubercles at hinder margin; fifth not expanded laterally, with a pair of posterior dorsal tubercles and one or two dorso-lateral tubercles.

Marsupium not visible from the side.

Pleon somites with faint imbricate-tuberculate patterning; first and second with fine median dorsal line and with three small dorso-lateral tubercles (similar

to those of carapace) on each side at hinder margin; fifth not cingulate and with a pair of small dorsal tumidities anteriorly; telsonic somite short, little produced, and rounded posteriorly.

Second joint of peduncle of first antenna shorter than first and a little longer than third; first segment of flagellum not much longer than second.

Second antenna two-jointed.

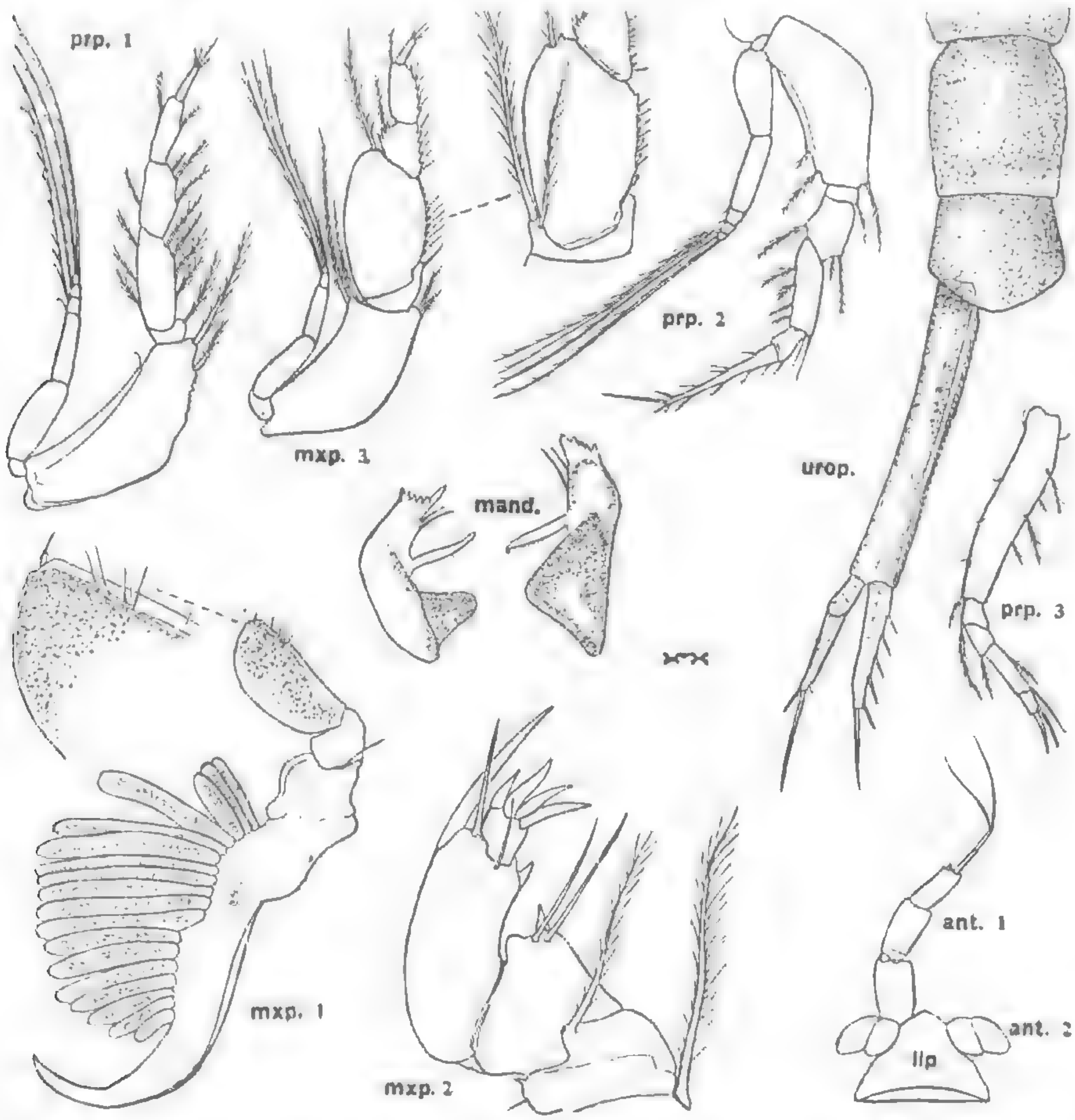

Fig. 40. *Campylaspis roscida*, paratype ovigerous female: lip, ant. and mand., upper lip, antennae and mandibles (× 62); mxp. and prp., maxillipeds and peraeopods (× 56; distal portions of first and second maxillipeds, × 144); urop., uropod with fifth pleon and telsonic somites (× 56).

First maxilliped with terminal joint minute, elongate, capped with a single bristle; eighteen gill-lobes.

Terminal joint of second maxilliped with four stout spines, three subequal in length and one shorter; penultimate joint with outer distal spine twice the length of spines of terminal joint, with two setae and with an inner distal tooth.

Third maxilliped with basis wide and short, not much longer than ischium, merus and carpus together; merus very large, fully as long as carpus, propodus and dactylus together, less than twice as long as wide, serrate on inner margin

but with no outstanding teeth; carpus serrate on inner edge and with three small teeth on outer margin; propodus narrower but slightly longer than carpus; serrate on inner edge and twice as long as dactylus.

First peraeopod with basis shorter than rest of limb; merus one-third as long again as carpus, which is longer than propodus and almost twice as long as dactylus.

Second peraeopod not longer than first, with basis as long as ischium to propodus together; dactylus as long as carpus and propodus together and with one of the terminal setae long, half the length of the joint.

Peduncle of uropoda subcylindrical, serrate on inner margin, about two and one-half times as long as telsonic somite, and as exopod; endopod scarcely longer than exopod, with five serrate spines on inner edge and a terminal spine more than half its length; exopod with slightly longer terminal spine and a shorter one.

Colour, pure milk white.

Length, 4·3 mm.

Loc. New South Wales: 5 miles east of Port Hacking; 100 metres, on mud ("Cronulla" Trawl Station, July, 1943); 4 miles off Eden, 70 metres, on silt (type loc., K. Sheard, Oct., 1943); 4 miles east of Port Hacking, 80 metres, on mud (K. Sheard, trawled, May, 1944). Tasmania: off Babel Island, lat. 39° 55′ S., long. 148° 31′ E. ("Warreen" Station 29. Jan., 1939). Type female in South Australian Museum, Reg. No. C. 2526.

As in some other species the ventral incubatory pouch of the ovigerous female is not bulging and prominent. In a female slightly smaller than the type (4·2 mm.) eleven embryos, each 0·4 mm. in greatest length, occupy almost all of the interior of the thorax.

The tubercles of the carapace are so small that they are perhaps better described as granules. Subadult examples sometimes have these more numerous but still smaller, and less conspicuous owing to a closer covering of short hairs.

This species is somewhat close to *thompsoni*; the most apparent differences in the adult female are the shorter peduncle of the uropod and the narrower carapace with its small tubercles; the joints of the first and second peraeopods are of different proportions. *C. laticarpa* Hansen (1920, p. 40, pl. iii, fig. 3) has similar sculpture of the carapace but the maxillipeds are very different.

CAMPYLASPIS ECHINATA sp. nov.

Adult male. Integument thin, but tough and somewhat flexible; pleon more highly calcified and more brittle than thorax; rather coarsely reticulate on carapace.

Carapace with numerous small blunt-ended spiniform projections densely placed on back and sides, sparser infero-laterally; at hinder margin the spines are longer and a pair of dorsal ones are particularly outstanding; interspersed is a sparse clothing of fine hairs; an elongate shallow depression on each side; an antero-lateral tumidity on each side, studded with spinules smaller than rest of armature; it is somewhat rectangular as seen from above, is depressed, twice as long as deep, and is barely as long as the pleon. Antennal notch distinct, rather narrowly excavate for the genus; angle rounded, margined with spines. Pseudorostral lobes widely truncate in front, meeting for a distance less than length of ocular lobe which is narrow, dilated anteriorly and is nearly twice as long as wide; no corneal lenses apparent.

None of pedigerous somites elevated dorsally but second to fifth each with a pair of outstanding spines on back, those of fifth nearly as deep as the somite; other spines are placed on sides and back of these somites while on the flattened-globose expanded pleural parts of each is a fan of four or five outstanding spines.

Pleon somites one to five with long and short spines on back and with upper edge of antennal furrow spinose; a few shorter spines infero-laterally; fifth somite without trace of transverse sulcus; telsonic somite rather narrow, distally rounded and moderately produced.

Second peduncular joint of first antenna shorter than first, longer than third and about as long as the flagellum, the two segments of which are subequal in length.

Last joint of peduncle of second antenna half as long again as penultimate.

First maxilliped with terminal joint more robust than usual in the genus, more than one-fourth as long as penultimate segment, not much more than twice as long as wide, slightly constricted near apex, which bears two minute setae, and with a row of tiny setae on outer distal edge; penultimate joint with some unequal short setae (see fig. 42) and two stout plumose setae; twenty-two gill lobes.

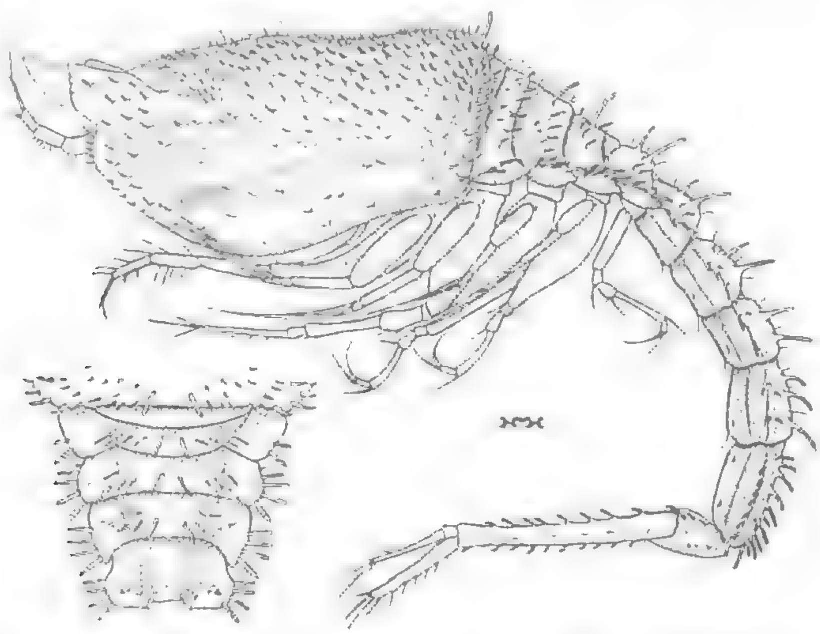

Fig. 41. *Campylaspis echinata*, lateral view and dorsal view of pedigerous somites (× 20).

Distal joint of second maxilliped with a short seta and two stout unequal spines, the longer not reaching to the level of the tip of the outer spines of the penultimate joint.

Third maxilliped with basis stout, longer than rest of limb, with serrations and distal tooth on inner edge; ischium with two inner blunt teeth; merus narrow, with small teeth in both margins and a large outstanding subdistal outer tooth, almost as long as the joint is wide; not including the teeth the merus is three times as long as wide and is not nearly as long as carpus and propodus together; carpus with denticles on inner edge and three separated outer teeth the middle one of which is long; propodus elongate, nearly half as long again as carpus, and unarmed.

First peraeopod with basis stout, longer than rest of limb, which is slender; merus serrate on both margins and with a larger outer tooth near distal end; carpus serrate on both edges, barely more than three-fourths length of merus and distinctly longer than the propodus, which is less than twice as long as dactylus.

Second peraeopod not longer than first, its stout basis longer than ischium to propodus together; dactylus longer than carpus, almost as long as carpus and propodus together and with longest terminal seta two-thirds its own length.

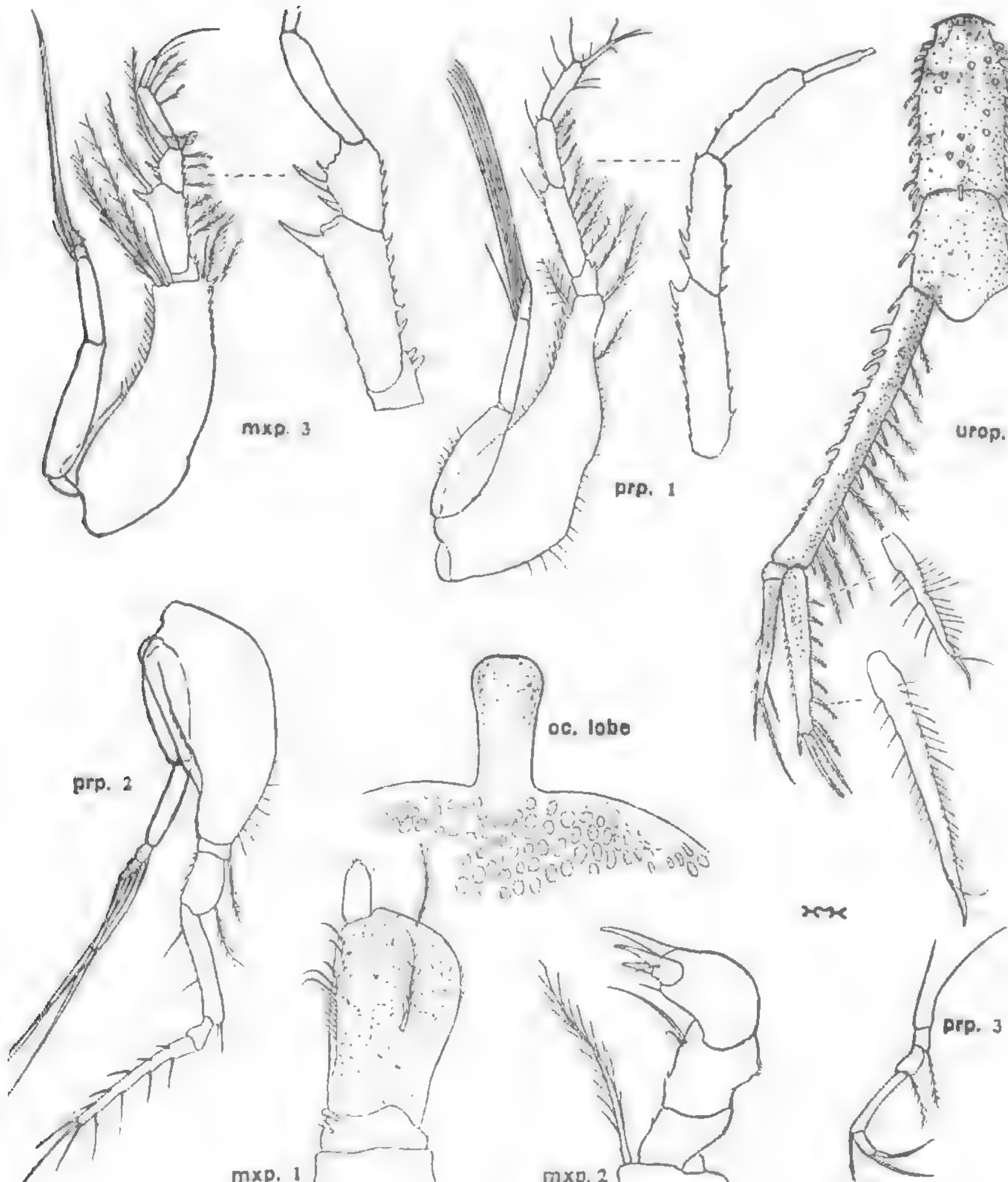

Fig. 42. *Campylaspis echinata,* type male; mxp. 1–2, distal portions of first and second maxillipeds (× 76); mxp. 3 and prp., third maxilliped and peraeopods (× 34; distal portions with plumose setae omitted, × 64); urop., uropod with fifth pleon and telsonic somites (× 34; spines of endopod, × 300).

Third to fifth peraeopods with carpus very slender and dactylus long.

Peduncle of uropod with long and shorter spiniform projections, more than twice as long as telson and less than twice as long as endopod; exopod distinctly shorter than endopod (four-fifths as long as it) with a spine on inner edge and two similar unequal terminal spines; endopod serrate on outer edge, with seven spines on inner margin and three terminal spines, one short, the others long and subequal in length.

Colour, yellow.

Length, 5·3 mm.

Loc. New South Wales: 4 miles off Eden, 70 metres, in silt (K. Sheard, submarine light, Oct., 1943). Type in South Australian Museum, Reg. No. C. 2534.

Details of the "spines" (composite setae) of the rami of the uropods are shown in fig. 42. Similar spines occur on the uropods of several other Australian species.

This form is readily recognized by the distinctive armature and the linguiform ocular lobe, dilated anteriorly as in *macrophthalma* Sars.

CAMPYLASPIS PUSTULOSA sp. nov.

Adult male. Integument calcified brittle, with coarse reticulate patterning on carapace.

Carapace with well spaced rounded, subconical tubercles, the antero-lateral ones prominent, and with a shallow very elongate depression on each side not margined by carinae or emphasized by disposition of tubercles; from above and also from the side it is roughly sub-rectangular in shape, wider than depth (which is half its length) and it is only as long as pleon. Antennal notch widely open and angle as seen from side rounded. Pseudorostral lobes widely truncate and finely denticulate in front, meeting for a distance less than length of ocular lobe. The last-named is dilated, not much longer than wide and is constricted at base; there is a lens at each side and a pair of much smaller ones at apex, which is incised.

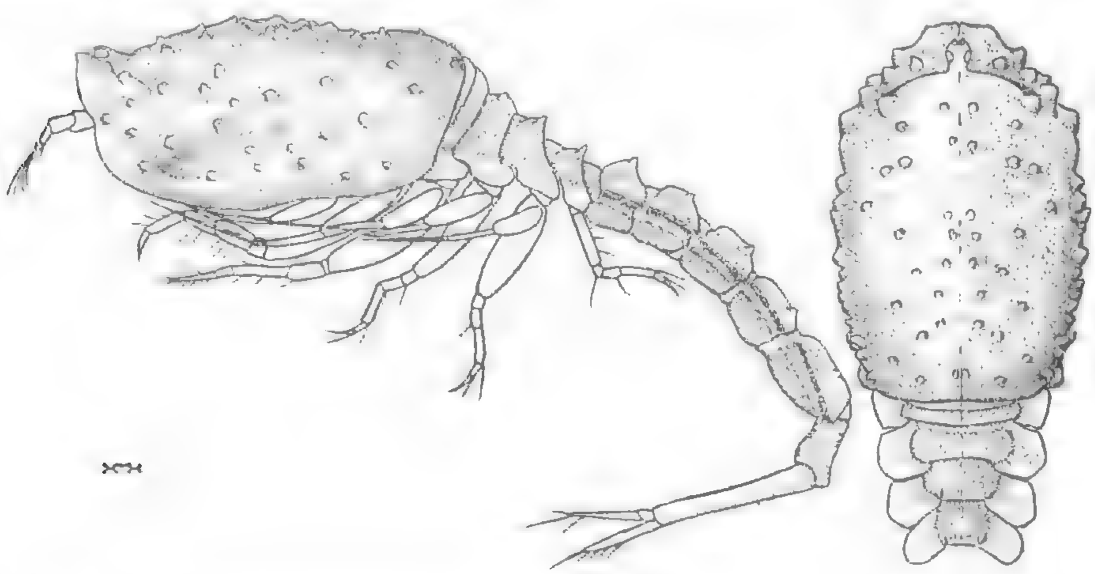

Fig. 43. *Campylaspis pustulosa*, lateral view and dorsal view of cephalothorax of type male (× 20).

First and second pedigerous somites rounded dorsally not at all produced; third slightly elevated dorsally and fourth and fifth each with a pair of angular dorsal tubercles each seated on a tumidity; pleural parts of second to fifth expanded and somewhat angularly rounded, with reticulate pattern as on carapace.

Pleon somites each with a pair of dorsal tubercles, which are angular when viewed from the side; on the fifth they are situated on a faint transverse sulcus, and on the telsonic somite at the proximal third; the upper margins of the antennal groove are serrate; telsonic somite moderately produced and rounded distally.

Second peduncular joint of first antenna longer than first and much longer than third, which equals the two-jointed flagellum in length.

Terminal joint of peduncle of second antenna more than twice as long as penultimate.

First maxilliped with terminal joint relatively large, fusiform, almost one-fourth as long as penultimate joint and capped with two setae, one short and one minute; epipod with about a score of gill-lobes.

Distal joint of second maxilliped with a spine and a slightly shorter strong seta; penultimate joint with a slender outer spine not nearly reaching the tip of distal spine and with an inner tooth and seta.

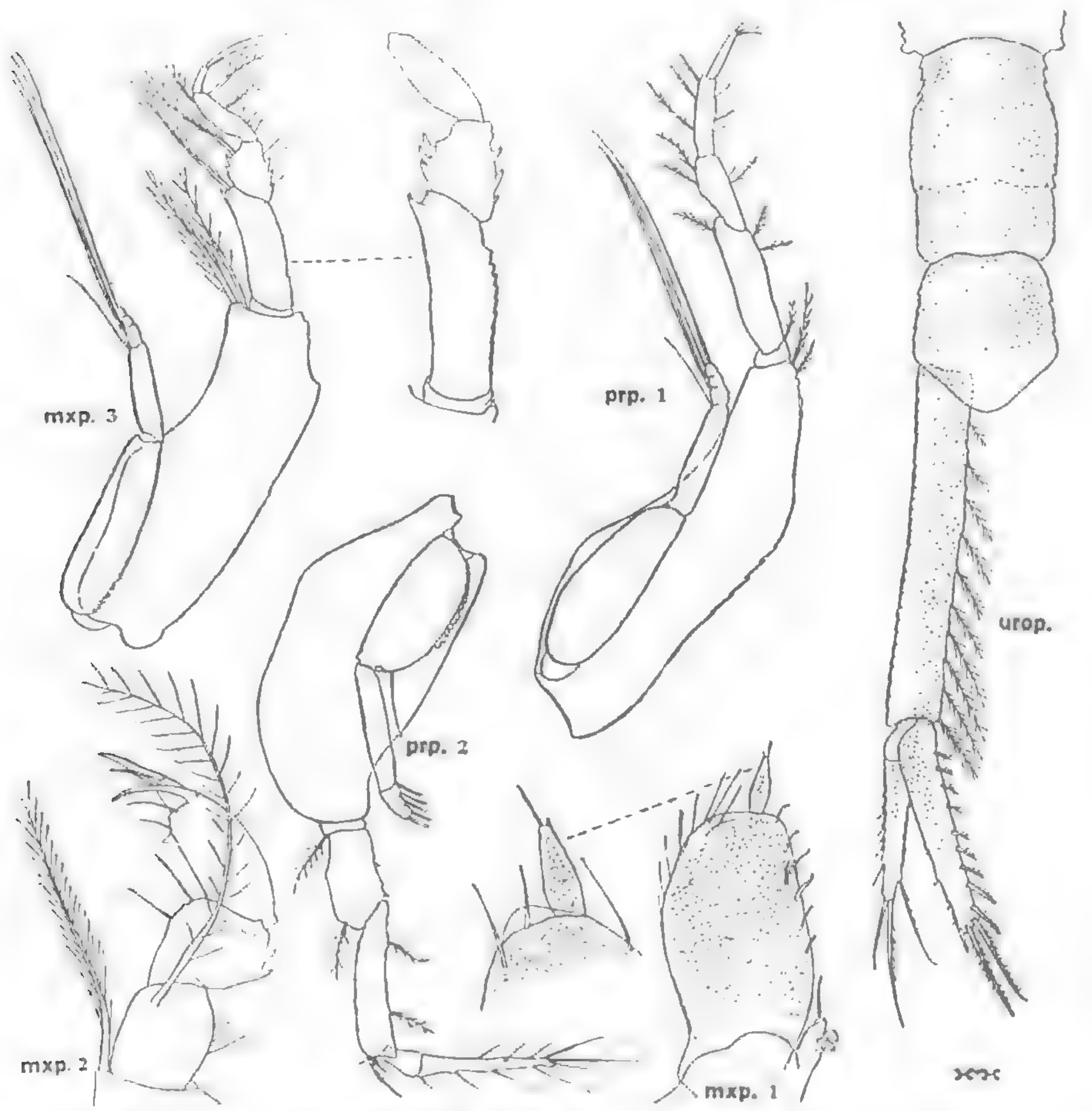

Fig. 44. *Campylaspis pustulosa*, type male; mxp. 1–2, distal portions of first and second maxillipeds (× 142; terminal joint of first, × 285); mxp. 3, prp. and urop., third maxilliped, peraeopods, and uropod with fifth pleon and telsonic somites (× 50; joints of maxilliped with plumose setae omitted, × 76).

Third maxilliped with basis wide, much longer than rest of limb; ischium very short, collar-like; merus narrow, almost as long as carpus and propodus together three times as long as wide, with a subdistal outer tooth and with inner margin serrate; carpus wider and shorter than propodus, with three teeth on each margin, those on outer edge crowded.

First peraeopod with basis wide, serrate on inner edge and longer than rest of limb, which is not dentate; merus more than one and two-thirds times as long

as carpus which is as long as propodus; dactylus distinctly more than half as long as propodus.

Second peraeopod as long as first, with basis wide but somewhat shorter than rest of limb; dactylus shorter than carpus, with its longest terminal seta two-thirds its length.

Peduncle of uropod with crenulate margins and inner plumose setae not very long; it is two and one-fourth times as long as the telsonic somite and twice as long as exopod; endopod one-fifth as long again as exopod with nine compound spines on inner margin and three terminal spines, one short the others long and subequal in length; the longest of the two unequal terminal spines of the exopod is as long as the second joint of that ramus.

Colour, white.

Length, 4·8 mm.

Loc. New South Wales: 4 miles east of Eden, 70 metres, in silt (K. Sheard submarine light, Oct., 1943). Type in South Australian Museum, Reg. No. C. 2518.

The spines of the rami of the uropoda are of the same type as those figured for *echinata* but the lateral projections are shorter. The maxillipeds are somewhat as in *echinata* but otherwise the two species exhibit many obvious differences.

CAMPYLASPIS ASPERA sp. nov.

Ovigerous female. Integument calcified, brittle, with coarse honeycomb-like pattern, particularly distinct on carapace.

Carapace studded with conical tubercles and with an elongate depression on each side, not margined by carinae or definitely outlined by rows of tubercles; the antero-lateral elevation is moderately emphasized, the dorsal contour is well arched and forms a decided angle at the base of the ocular lobe; viewed from above the carapace is ovoid in shape, broader than deep, its greatest width three-fours of its length; it is one-half the total length of the animal. Antennal notch widely open; angle, and inferior margin behind it, finely dentate. Pseudorostral lobes concave in front and meeting for a distance less than the length of the ocular lobe, which is a little longer than wide, has a minute incision at apex, and bears three corneal lenses (the anterior one divided) in the front half.

Pedigerous somites not at all elevated; like the carapace each is marked with a fine, wavy median line, pleural parts of second to fifth expanded and, seen from above, subacute laterally: there is a pair of dorsal tubercles on each of the third to fifth somites.

Marsupium bulging and prominent; ova 0·28 mm. in diameter.

Pleon somites one to five each with a pair of small dorsal tubercles at hind margin and with a low oblique dorso-lateral ridge, which terminates posteriorly in a little projection; fifth somite with well-marked transverse sulcus; telsonic somite widened posteriorly, apex rather angular but not much produced.

Second peduncular joint of first antenna distinctly longer than third and as long as the flagellum, the two joints of which are subequal in length.

First maxilliped with terminal joint elongate, nearly one-fifth as long as penultimate segment and capped with a single seta; marginal setae of penultimate joint stout; ten gill lobes plus one reflexed.

Distal joint of second maxilliped with two spines, one twice as long as the other; penultimate joint with a somewhat bent outer spine (which reaches level of tip of the shorter distal spine) and with an outer tooth and slender seta.

Third maxilliped elongate, with basis fully as long as rest of limb; merus twice as long as wide, rather longer than carpus and propodus together, and with a prominent subdistal tooth (as well as a couple of smaller teeth) on outer margin and

with a few small teeth on inner; carpus wider and barely longer than propodus, with three outer teeth and two denticles on inner margin; dactylus half as long as propodus.

First peraeopod with basis serrate on inner margin near distal end, and fully as long as remainder of limb; ischium with an inner tooth; merus with an outer subdistal tooth, nearly half as long again as carpus, which is subequal in length to propodus and twice as long as dactylus.

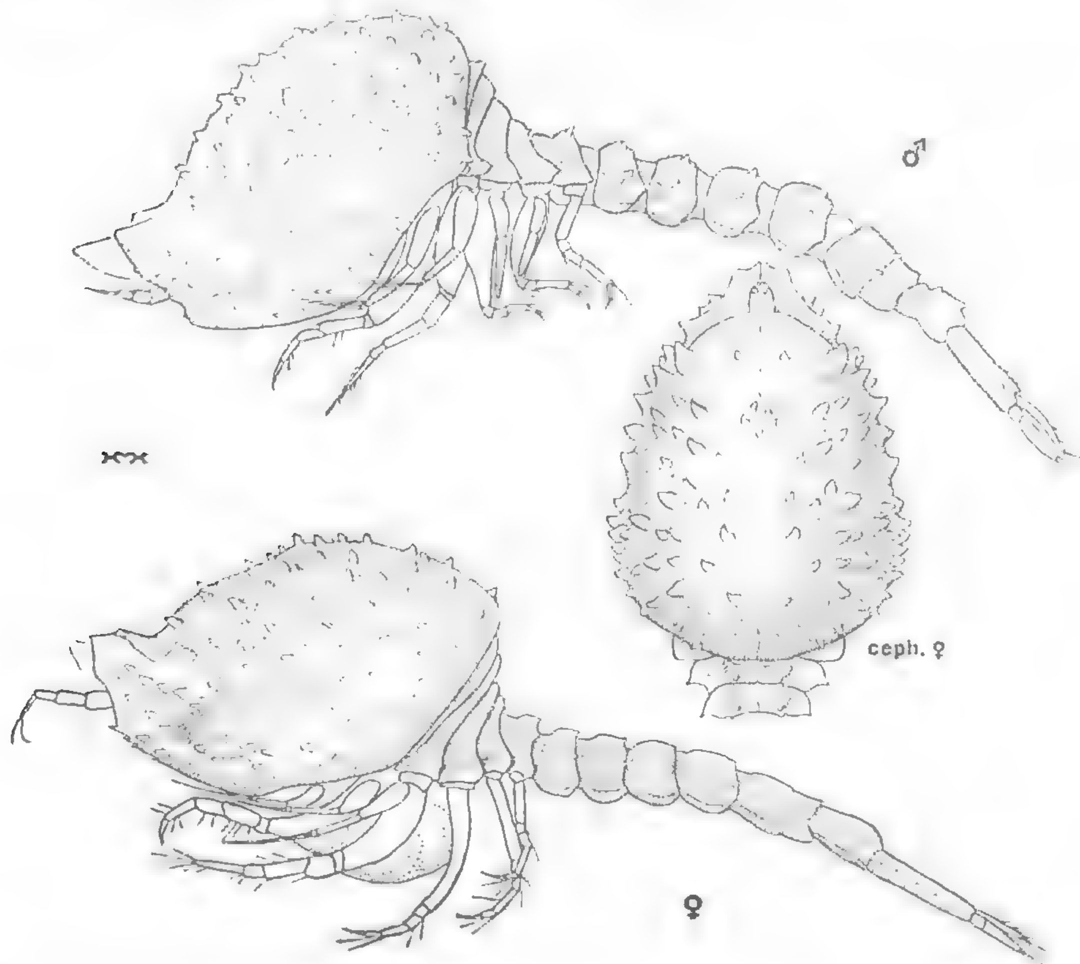

Fig. 45. *Campylaspis aspera*; lateral views of type ovigerous female and paratype subadult male, and cephalothorax of type female from above (× 22).

Second peraeopod longer than first, with the stout basis as long as ischium to propodus together; dactylus a little shorter than carpus and equal in length to its longest terminal seta.

Peduncle of uropod ridged above and serrate on both margins, nearly one and two-thirds times as long as telsonic somite and as endopod, which is a little longer than exopod; four spines, successively increasing in length, and interspersed with a few tiny spines, on inner edge of endopod and two very unequal ones at apex; exopod with two unequal terminal spines, the longer equal in length to that of the other ramus.

Colour, yellow, patterned on pleon with purplish brown.

Length, 3·9 mm.

Subadult male. This is figured because, like some adult females, it has the tubercles of the carapace rather more distinctly arranged in rows. The honeycomb-like sculpture is very distinct and some of the tubercles above the lateral depression are larger than the others. The small tubercles on the pleon are rather more distinct than in the female and the fifth somite is strongly cingulate; the dorso-lateral ridges are feebly serrate.

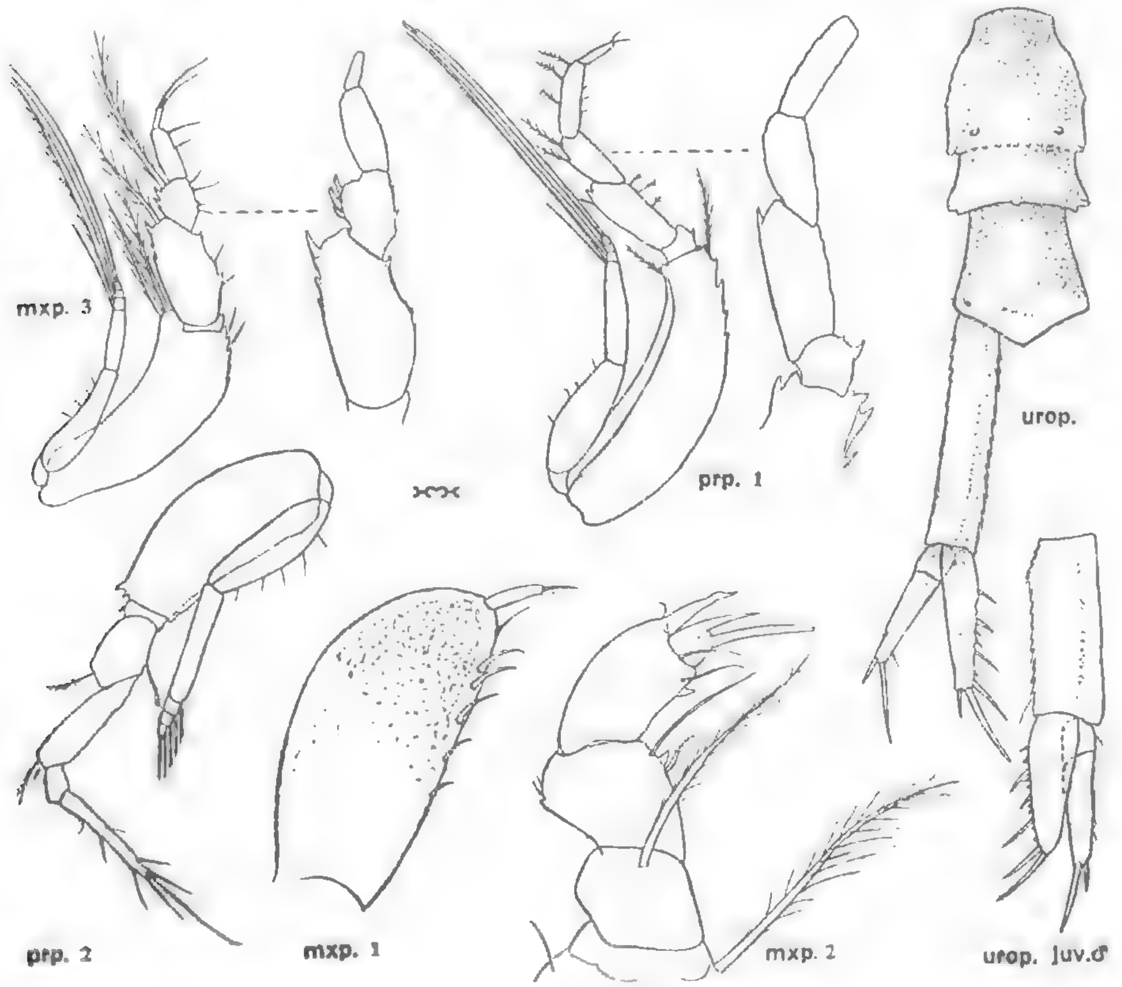

Fig. 46. *Campylaspis aspera*, paratype female; mxp. 1–2, distal portions of first and second maxillipeds (× 144); mxp. 3, prp. and urop., third maxilliped, peraeopods, and uropod with fifth pleon and telsonic somites (× 50; distal portions with plumose setae omitted, × 75). urop., juv., uropod of young male (× 50).

The carapace is narrower than in the female; the ocular lobe is wider, is slightly constricted at the base, and slightly incised at apex.

There is a pair of dorsal tubercles on the telsonic somite and a broken median carina.

The maxillipeds are as illustrated for the female.

The uropod (fig. 46, urop. juv.) has the peduncle shorter and wider than in the adult.

Although this male is as large as the ovigerous females, the abdominal antennal groove has not yet developed (the second antennae are still short).

Loc. New South Wales: 5 miles east of Port Hacking, 100 metres, on mud ("Cronulla" Trawl Station, July, 1943); 4 miles east of Eden, 70 metres, in

silt (type loc., K. Sheard, trawled Oct., 1943); 4 miles east of Port Hacking, 80 metres, on mud (K. Sheard, trawled May, 1944). Type female in South Australian Museum, Reg. No. C. 2517.

C. aspera is close to *antarctica* Calman (1907, p. 5, pl. i, fig. 14–16 and text fig. 1; and 1915, p. 155, fig. 9). In the last-named, however, the merus of the third maxilliped is much smaller, being considerably less than length of carpus and propodus combined. It likewise resembles the Northern *verrucosa* Sars (see Hansen, 1920, p. 45, pl. iii, fig. 8a) but differs in the strongly developed transverse sulcus of the fifth pleon somite, the shorter peduncle of the uropod and in having the tubercles of the carapace less flattened.

CAMPYLASPIS THETIDIS sp. nov.

Female. Integument strongly calcified.

Carapace studded with rounded tubercles, which tend to fall into rows; sides with two parallel longitudinal ridges, bounding a large subquadrate, depressed area at top and bottom; the upper carina is strongly tuberculate and extends from above the antennal notch to beyond second third of carapace, the lower ridge is less markedly tuberculate; above the upper carina there is a longitudinal dorsolateral tuberculate elevation and towards the front is the usual antero-lateral prominence emphasized in sculptured species, in this case a tubercle larger than the

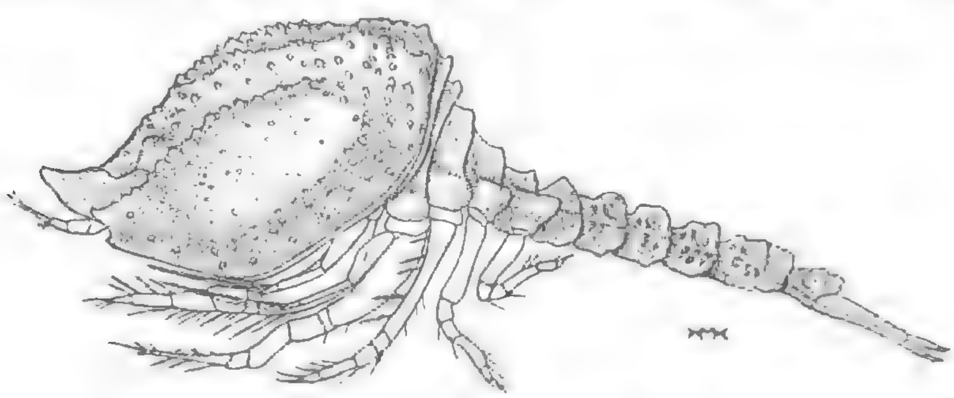

Fig. 47. *Campylaspis thetidis*, type female (× 14).

others. The back of the carapace is marked with a very fine median line anteriorly but is longitudinally sulcate for the greater part of its length, the furrow expanded posteriorly over the cardiac region where there is a short median longitudinal carina, which is one-sixth of the length of carapace. Viewed from above the carapace is subquadrate, about as wide as deep and not quite two-thirds as wide as long; it is as long as pedigerous and first to fifth pleon somites. Pseudorostral lobes narrowing to the front, very oblique in lateral view, and meeting for a distance equal to three times length of ocular lobe, which is small, longer than wide, and with no apparent corneal lenses. Antennal notch wide but distinct; angle with small denticles, subacute.

Pedigerous somites each with a pair of low dorsal tubercles near hinder margin; first and second dorsally very short but slightly elevated; pleural parts of second to fifth expanded and inflated, in second rounded laterally, in last three angular and slightly produced backwards.

First two somites of pleon with transverse dorsal carina, from which branch off a pair of short longitudinal ridges, which are faint on the first; third to fifth somites each with median carina (rugose owing to prostrate serrations) and a similar transverse ridge crossing it near posterior end; fifth with a second collar-

like transverse ridge, posterior to which is a sulcus dividing the somite into two parts; dorso-lateral edges ridged and below them, on anterior portions of first to fifth there is a short lateral carina; the spaces between carinae have an eroded appearance; posterior half of telsonic somite triangular as seen from above, and (for the genus) well produced.

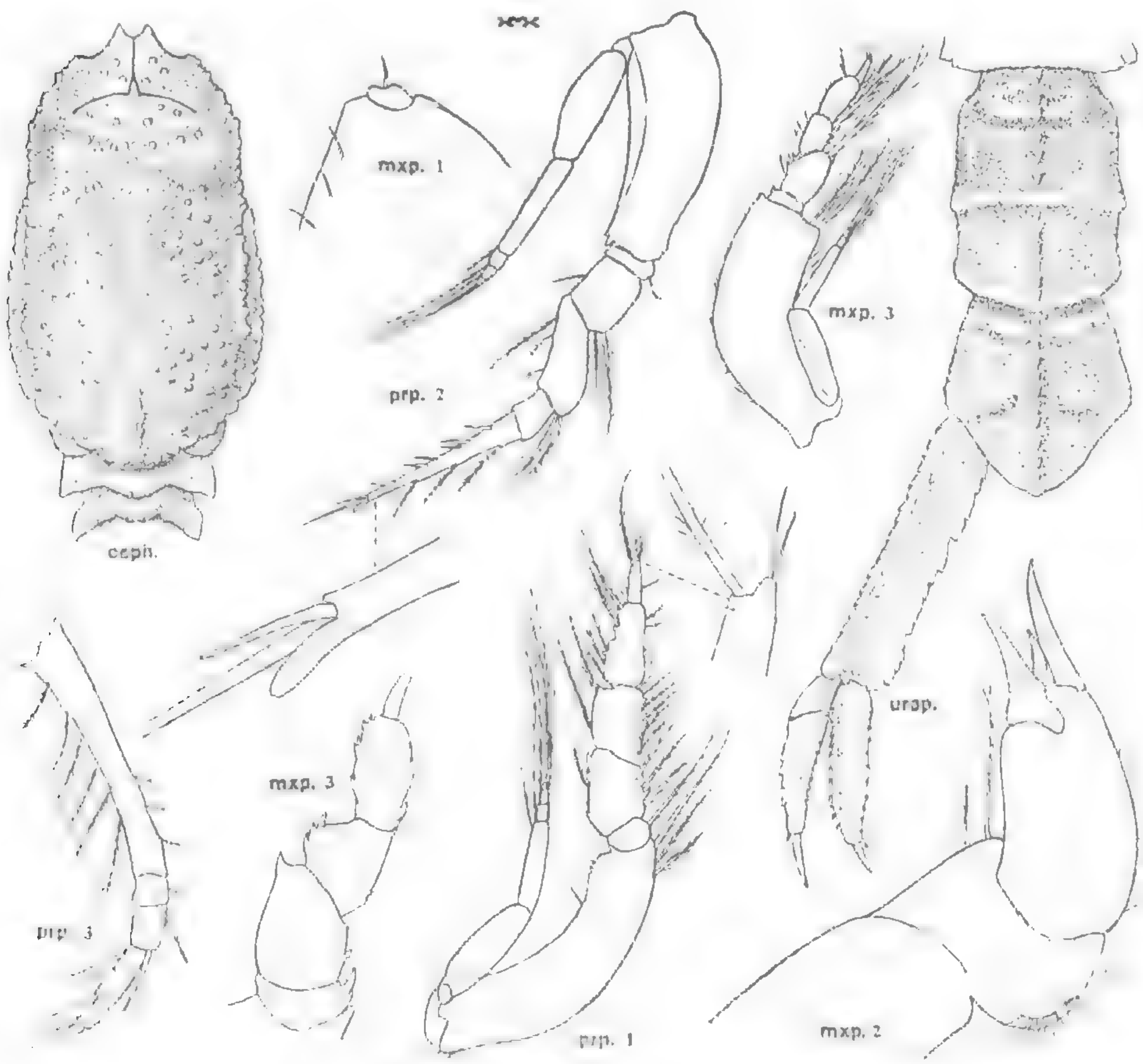

Fig. 48. *Campylaspis thetidis*, type female; ceph., cephalothorax from above (× 14); mxp. 1–2, distal portions of first and second maxillipeds (× 125); mxp. 3, and prp., third maxilliped and peraeopods (× 23; palp of maxilliped with setae omitted, × 56; distal end of dactylus of first and second peraeopods, × 125); urop., uropod with fifth pleon and telsonic somites (× 43).

First maxilliped with last joint minute, wider than long, and with a single seta.

Terminal joint of second maxilliped with two unequal stout spines, the longest not reaching tip of the stout outer distal spine of penultimate segment.

Third maxilliped robust; basis considerably longer than rest of limb; ischium with inner tooth; merus not much enlarged, less than half as long again as width, barely longer than propodus, with one or two small dentations on inner edge and an outer distal tooth; carpus wide, with three small outer teeth of equal size; propodus stout, with edges serrate, more than twice as long as dactylus.

First peraeopod with basis barely as long as rest of limb; merus, carpus and propodus wide, subequal in length; dactylus half as long as propodus with one of the three distal setae longer than itself.

Second peraeopod longer than first, with the stout basis much shorter than rest of limb, but longer than ischium to propodus together; dactylus as long as merus and carpus together, with a curious distal lobe, alongside which are inserted the two terminal setae, the longer of which is half as long as the joint.

Peduncle of uropod triangular in section, the apex of the median ridge and both edges jaggedly serrate; it is half as long again as telsonic somite and three-fourths as long again as the subequal rami; endopod serrate on both edges, with a toothed dorsal ridge and with two stout terminal spines, one very short; exopod with serrate edges, its apex with a stout spine, which is longer than that of endopod, and a tiny spine.

Colour, yellow.

Length, 6·6 mm.

Loc. New South Wales: off Cape Three Points, 41–50 fath., on sticky mud and shell ("Thetis" Station 13, Feb. 1898). Type in Australian Museum, Reg. No. G. 2225.

Although he makes no special comment regarding it, Calman's figure of the second peraeopod of *rostrata* (1905a, pl. ii, fig. 37) shows that in that species also the distal seta of the dactylus, though much shorter, is subterminal, the end of the joint projecting beyond its insertion; further, the joints of this appendage are of the same proportions as in *thetidis* which, however, exhibits obvious differences in body sculpture and has a shorter pseudorostrum.

Hansen (1920, p. 42, pl. iii, fig. 5) illustrates the second and third maxillipeds of *rostrata;* the second pair are much as in *thetidis* but in the third the merus is narrower and the carpus relatively smaller.

Genus PROCAMPYLASPIS Bonnier.

Procampylaspis Bonnier, 1896, p. 541; Stebbing, 1913, p. 184 (syn. and key); Hansen, 1920, p. 33.

This stable, widely distributed genus, is much more sparsely represented by species than is *Campylaspis.* It is well-defined, particularly in the character of the rake-like dactylus of the second maxilliped and the strikingly long ischium of the first peraeopod. Six species have been described previously and the first Australian form is recorded below.

KEY TO SPECIES OF *PROCAMPYLASPIS.*

1. Distal prolongation of dactylus of second maxilliped long and slender, nearly three times as long as rest of joint .. .. *macronyx* Hansen.
   Distal prolongation of dactylus of second maxilliped at most not much longer than rest of joint .. .. 2.
2. Carapace with numerous dorsal tubercles in male, none in female *bonnieri* Calman.
   Carapace with one or two dorsal tubercles .. .. 3.
3. Carapace with one median dorsal tubercle .. .. 4.
   Carapace with two dorsal tubercles .. .. 6.
4. Dactylus of second maxilliped with three teeth on inner margin *tridentata* Stebbing.
   Dactylus of second maxilliped with four teeth on inner margin .. .. .. 5.
5. Dactylus of second peraeopod fully as long as (male), or longer than (female), carpus and propodus combined .. .. *armata* Bonnier.
   Dactylus of second peraeopod only as long as carpus .. .. *sordida* sp. nov.
6. Ocular lobe tuberculiform and with a pair of denticles. Dorsal tubercles of carapace placed one behind the other, each bidentate .. .. .. *compressa* Zimmer.
   Ocular lobe narow, not tuberculiform. Dorsal tubercles of carapace placed one on each side, and each with one small spine .. .. *bituberculata* Hansen.

PROCAMPYLASPIS SORDIDA sp. nov.

Ovigerous female. Integument well calcified; form as in genotype.

Carapace about two-fifths of total length, with shagreen-like surface owing to numerous very small rough tubercles or spines; seen from the side it is prominently arched above, forms a decided angle posterior to ocular lobe and is markedly tumid at posterior end; there is a single prominent median, conical tubercle just behind middle of length. Antennal notch widely open and angle very obtuse. Ocular lobe narrow; no corneal lenses; pseudorostral sutures ankylosed; lobes reaching a little beyond eye-lobe.

First pedigerous somite with a closely applied lamella, the bifid apex of which just overlaps posterior margin of carapace medianly; second somite not at all elevated and without projections or lamella.

Pleon somites a little irregular but unarmed, successively increasing in length to fifth; telsonic somite widest in posterior half (as wide as long) somewhat angularly rounded, little produced posteriorly and about four-fifths as long as fifth pleon somite; the latter is slightly but distinctly widened in posterior third, where it is one-fourth as wide again as breadth at posterior margin.

First maxilliped with terminal joint rather wide, one-third as long as penultimate, with a single apical seta and with two dentiform projections on outer edge (see figure for other details).

In the dactylus of the second maxilliped immediately posterior to the large falcate apical tooth there is a stout but very short spine, at the base of which is a seta of about the same length; this is followed by three large inner teeth, subequal in length to the apical tooth of the joint and of about the same diameter; the most anterior of these has a faint suture near the base and the next has an insignificant accessory proximal tooth; the posterior spine is equal in length to the falcate end of the dactylus and is a little longer than the other inner spines.

Third maxillipeds with basis almost as long as rest of limb; ischium short, with an inner tooth; merus widest distally, where it is barely half as broad as its length, and bears a slender outstanding spine on outer margin; there is no other armature on the joint; carpus less than half as long as merus, with a spine on outer margin and another on the inner; propodus without armature, more than half as long as merus, and half as long again as dactylus.

First peraeopod unarmed, with basis not much more than two-thirds as long as rest of limb (as long as ischium, merus and carpus together); ischium subequal in length to propodus and longer than carpus which slightly exceeds the merus in length; dactylus half as long as propodus.

Second peraeopod with basis stout, somewhat longer than ischium to propodus together; merus distinctly more than half as long as carpus; dactylus subequal in length to carpus and about four times as long as propodus.

Peduncle of uropod two and one-fifth times as long as telsonic somite; endopod equal in length to last-named and a little longer than exopod, with two spines on inner margin and two very unequal terminal spines.

Colour (when cleaned) dull yellow, without any markings.

Length, 4·5 mm.

Adult male. Carapace nearly one-third of total length; surface with small clear-cut reticulation; posteriorly and near lower edge is a row of denticles; on the back the median conical tubercle is not quite as high as in female and there is a pair of spines near the hinder margin. Antennal notch widely open and antennal angle more prominent and less obtuse than in female.

First pedigerous somite without lamina; second to fifth somites each with a pair of dorsal spines, and with one or two spines on expanded pleural portions.

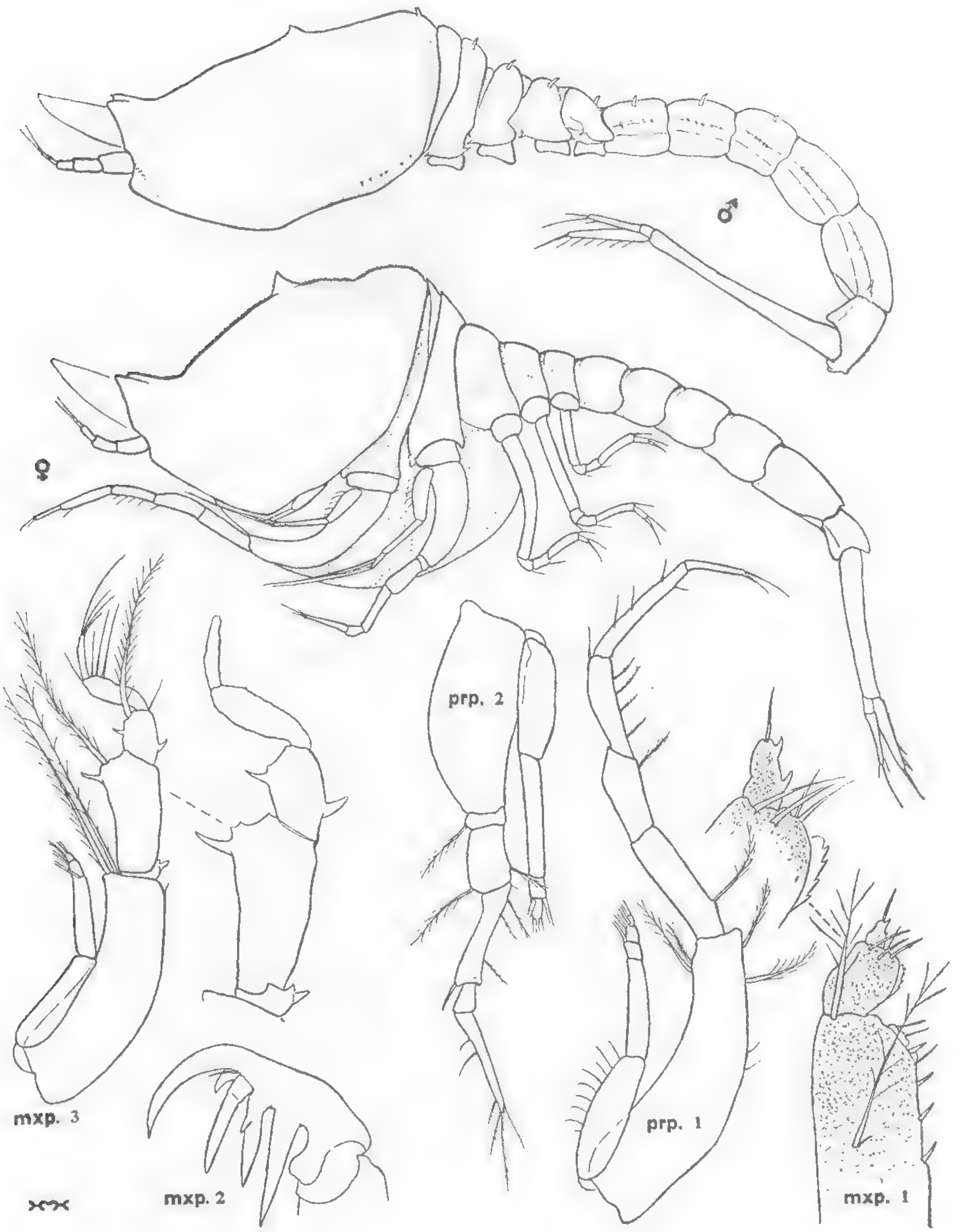

Fig. 49. *Procampylaspis sordida.* Type female and male from the side (× 22). Paratype ovigerous female; mxp. 1–2, distal portions of first and second maxillipeds (× 144; terminal joint of first, × 324); mxp. 3 and prp., third maxilliped and peraeopods (× 50; distal joints of maxilliped, with plumose setae omitted, × 77).

Pleon somites with upper edge of antennal groove spinose (first to fourth); first three each with a pair of dorsal spines; fifth somite slightly widened proximally as in female.

Peduncle of uropod two and three-fourths times as long as telsonic somite and two and one-third times as long as endopod, which has half a dozen spines on inner edge.

Length, 5·5 mm.

Loc. New South Wales: 5½ to 7½ miles off Cape Three Points, 41–50 fath., on sticky mud and shell ("Thetis" Station 13, Feb., 1898); 5 and 4 miles east of Port Hacking, 100 and 80 metres on mud ("Cronulla" Trawl Station, July, 1943 and July, 1944); 4 miles off Eden, 70 and 60 metres, in silt (type loc., K. Sheard, Oct. and Dec., 1943). Types in South Australian Museum, Reg. No. C. 2531–2532.

This species is extraordinarily close to the genotype *armata* Bonnier (1896, pp. 541 and 544, pl. xxix, fig. 1–2) from northern latitudes (40°–61°), but according to the descriptions there are differences sufficient to warrant separation, especially in view of the widely separated regions.

Bonnier's figures and those of Calman also (1906, p. 419, pl. xxvii, fig. 13–20) show the posterior end of the carapace of the female as less tumid than in that sex of *sordida* and the fifth pleon somite is scarcely or not at all dilated proximally. The second maxilliped is similar, but the first large tooth (behind the falcate termination of the last joint) is more slender and the next has no accessory tooth; also, the two large proximal teeth are wider. The carpus of the third maxilliped has the inner margin of carpus dentate but with no large outstanding tooth, and the merus is toothed on its inner edge. Bonnier shows the dactylus of the second peraeopod as longer than (female), or fully as long as (male) the carpus and propodus combined; in *sordida* it is much shorter.

Calman states that *armata* is commonly encrusted with mud. All examples of the Australian form are thickly clogged with silt and organic material. So closely does the covering adhere that it was necessary to boil the third maxillipeds and peraeopods, after removal, in weak caustic and to then brush off the deposit before details could be made out. The character of the surface of the body cannot be seen until the concealing material is removed but the coating together with the dorsal prominence of the carapace and the general shape make it very easy to separate the species from other Cumacea in the samples.

SUMMARY.

Twenty-five species of the family Nannastacidae, from southern and eastern Australia are described as new and others are discussed. The new forms are: *Nannastacus inconstans, clavatus, asper, sheardi, inflatus, subinflatus* and *johnstoni*. *Schizotrema aculeata*. *Cumella munroi, cana* and *turgidula*. *Campylaspis thompsoni, similis, unisulcata, uniplicata, rupta, latidactyla, minor, triplicata, roscida, echinata, pustulosa, aspera* and *thetidis*. *Procampylaspis sordida*.

The monotypic *Picrocuma* Hale is included in the family and keys are given to the species of the large genera *Nannastacus* and *Campylaspis*. The new *Procamplaspis* closely resembles the boreal genotype.

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AUSTRALIAN ACARINA
THE GENERA BRACHYCHTHONIUS BERL. AND COSMOCHTHONIUS BERL. (HYPOCHTHONIDAE-ORIBATOIDEA)

By H. Womersley, F.R.E.S., A.L.S., Entomologist, South Australian Museum

Summary

The species of the genera dealt with in this paper are very small, colourless to yellow mites found inhabiting moss. Owing to their small size, under 0.30 mm. in length, special methods of collecting are required, generally by putting the moss through the special funnel invented by Berlese. Hitherto the genera have not been recorded from Australia, but recently in samples of moss brought back from Normanville (September, 1943) and Quorn, South Australia (November, 1943), I have found representatives of five species of which three can probably be referred to European forms, the others being new. The specific characters of these small mites, of which about a dozen species are described, are found in the presence or absence of dorsal sculpturing, and when present its nature, and more particularly in the structure and comparative length of the sensillary or pseudostigmal setae, and of the normal dorsal setae. Unfortunately workers on this group have been content with comparing the lengths of the dorsal setae of the various species in general terms and not in actual dimensions. With such mites as these inhabiting moss, and of which both the mosses and the mites are extremely archaic and cosmopolitan, or widely spread by commerce, or both, it is extremely difficult to refer specimens to descriptions from other countries without access to authentic material, unless actual setal lengths are given.

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Consequently while some of the species here recorded from South Australia are only referred to European forms, the setal lengths of the latter are required for a final decision.

Genus BRACHYCHTHONIUS Berlese. 1910.

Acari Nuovi. Manip. VI. Redia 6, p. 219, 1910. Genotype *B. brevis* (Mich., 1888).

Belonging to the subfamily Hypochthonidae of the Oribatoidea, differentiated by the mandibles being more or less covered by the rostrum; a distinct separation of propodosoma and hysterosoma; the anal and genital openings occupying most of the area behind coxae IV, broadly contiguous, the anal opening usually narrowing posteriorly; and the hysterosoma with one or more transverse sutures. The genus is distinguished by two sutures forming 3 plates on the hysterosoma, of which the anterior suture is entire, and by having none or only a single lateral plate.

BRACHYCHTHONIUS cf. PERPUSILLUS Berl. 1910.

Acari Nuovi, Manip. VI. Redia 6, 220, fig. 41, 1910; *nec.* Jacot, 1936.

Fig. 1 A-C.

Light coloured species, 234μ long by 117μ wide. Sensillary setae 32μ long with fusiform head of about half its length furnished with several longitudinal rows of 5 denticles in each; the basal cup is 12μ long with the mouth 10μ in diameter. Dorsal setae acicular-foliaceous with prominent rib, similar on both propodosoma and hysterosoma, rostral and interlamellar setae 16μ long, remainder 13μ.

Jacot, 1936 (J. Elisha Mitchell Scientific Society, 52 (2) 247) has referred a number of specimens from North Carolina to this species. In his description and very careful figure, however, he shows the posterior interlamellar setae between the pseudostigmal organs, and also the exopseudostigmal setae as being very much smaller and of a different form to the remainder of the propodosomal setae. In Berlese's figure, however, and in my Australian material all the propodosomal setae are of the same structure.

Loc. A number of specimens isolated from moss from Normanville, S. Aust., 9/43 (H. M. Cooper) by the Berlese funnel.

BRACHYCHTHONIUS cf. HORRIDUS Sellnick, 1929.

Tierwelt Mitteleuropas. Bd. III. Abt. 9, 23.

Fig. 1 D–G.

Light to yellowish species. 208μ long by 105μ wide. Sensillary setae 39μ in length, with fusiform head of half its length furnished with several longitudinal rows of 10–12 fairly long denticles; the basal cup about as long as its mouth is wide. Dorsal setae 24μ long, foliate with prominent midrib and ciliated or dentate margins, all setae similar except the pair (posterior interlamellar) between the pseudostigmal organs which are shorter and scale-like.

I can only refer these specimens to Sellnick's species as diagnosed in his key (*loc. cit.*). They are somewhat similar in the dorsal setae to Jacot's *fimbriatus* from North Carolina, but in the drawings and description of that species the exopseudostigmal setae are given as very much shorter than the rest and tri- to quinquetrous in form.

Loc. A number of specimens from moss from Normanville, S. Aust., 9/43. (H. M. Cooper).

BRACHYCHTHONIUS LONGIPILUS sp. nov.

Fig. 1. H–J.

Description. Yellowish species, 182μ long by 90μ wide. Sensillary setae 32μ long with fusiform head of half its length furnished with longitudinal rows of 10–12 fine fairly long denticles; the basal cup slightly longer than wide at the mouth. Dorsal sutures much wider than in other species, especially between the propodosoma and hysterosoma. Dorsal setae all long, 40μ, slightly curved and simple, not at all foliate, the rostral and anterior interlamellar setae slightly shorter but not otherwise different.

Loc. A few specimens from the same habitat and localities as above species. Also 9 specimens from debris under tree ferns, Waterfall Gully, S. Aust., 5/35 (R.V.S.).

Remarks. Abundantly distinct from all other described forms in the long simple dorsal setae.

BRACHYCHTHONIUS PARALLELUS sp. nov.

Fig. 1. K–M.

Description. A strongly yellow chitinized species with the dorsum sculptured in 4 parallel irregular longitudinal ridges. Length 185μ, width 96μ. Sensillary setae 32μ long, with fusiform head of half the length, furnished with longitudinal rows of denticles or ciliations; cup about twice as long as wide at the mouth. Dorsal setae very short, 11μ, fine simple, and all similar; those on the hysterosoma are placed on the longitudinal ridges.

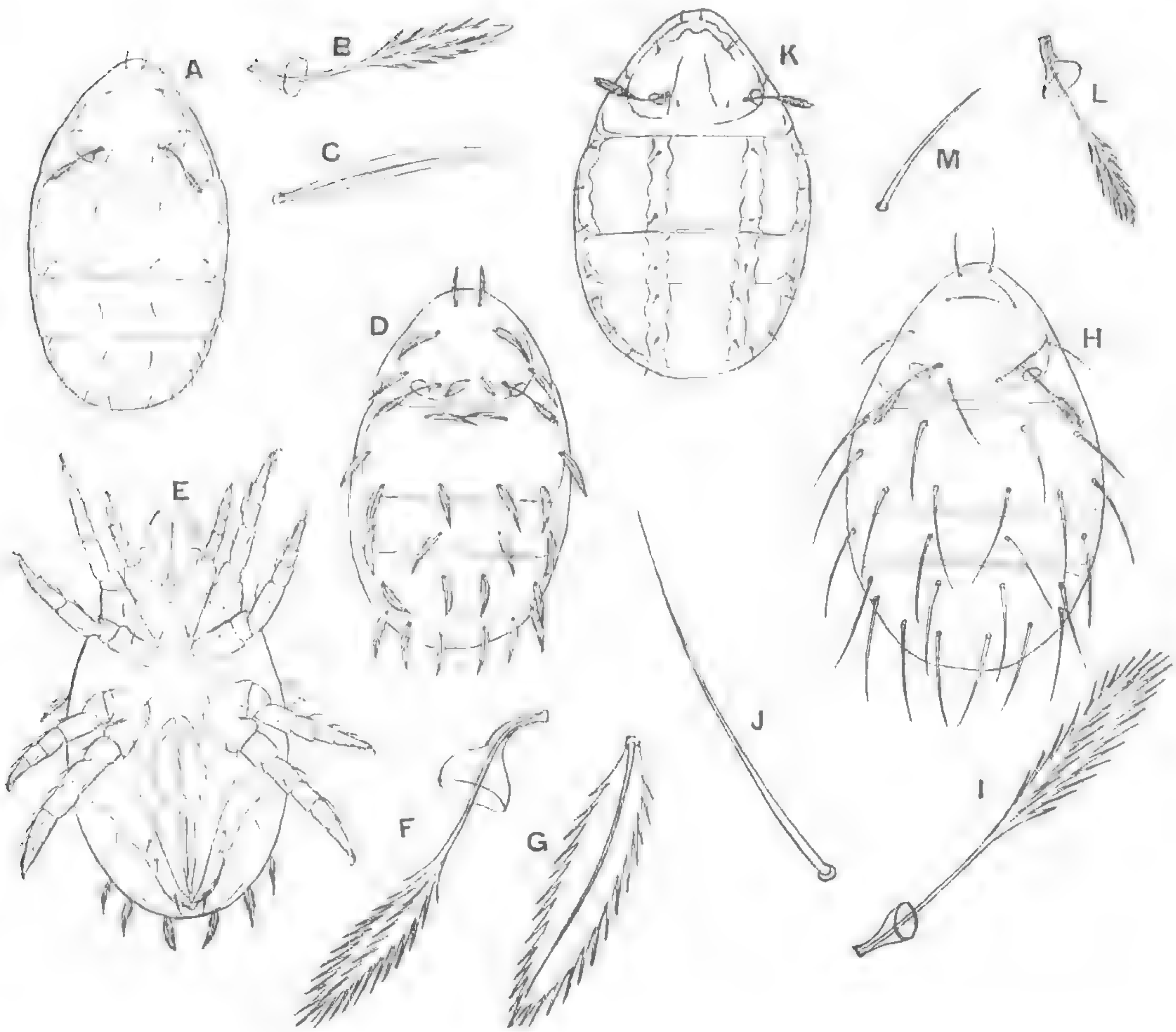

Fig. 1. A–C. *Brachychthonius* cf. *perpusillus* Berl. A. dorsum, B. sensillary organ and seta, C. dorsal seta; D–G. *B.* cf. *horridus* Sellnick. D. dorsum, E. ventral, F, sensillary organ and seta, G. dorsal seta; H–J. *B. longipilus* sp.n. H. dorsum, I. sensillary organ and seta, J. dorsal seta; K–M. *B. parallelus* sp.n. K. dorsum, L. sensillary organ and seta, M. dorsal seta.

Loc. A single specimen from the above habitat and locality. The species also occurs in similar habitat in the New Hebrides.

Remarks. This species might be included in the group of sculptured forms which includes the European *brevis* (Michael) but is abundantly distinct in the form of sculpturing.

Genus COSMOCHTHONIUS Berl., 1910.

Acari Nuovi. Manip. VI. Redia VI 221. 1910. Genotype *Hypochthonius lanatus* Mich. 1888.

Hypochthonidae with the hysterosoma divided by 3 sutures into 4 divisions. Dorsal setae of the two median divisions long and long ciliated. Sensillary setae appearing spindle-like, long.

COSMOCHTHONIUS PLUMATUS Berl. 1910.

Acari Nuovi. Manip. VI. Redia VI. 1910, 221, pl. xx, fig. 48.

var. AUSTRALICUS nov.

Fig 2. A–C.

Description. Colour light yellowish. Length 256μ, width 160μ. Hysterosoma with 3 suture lines dividing it into 4 sections. Propodosoma with sensillae 80μ long, ciliated and appearing spindle-like but only long ciliated on the apical half and only indistinctly and very shortly on basal half; with rostral, lamellar and interlamellar hairs, and a pair of hairs outside sensillae bases; all these hairs are

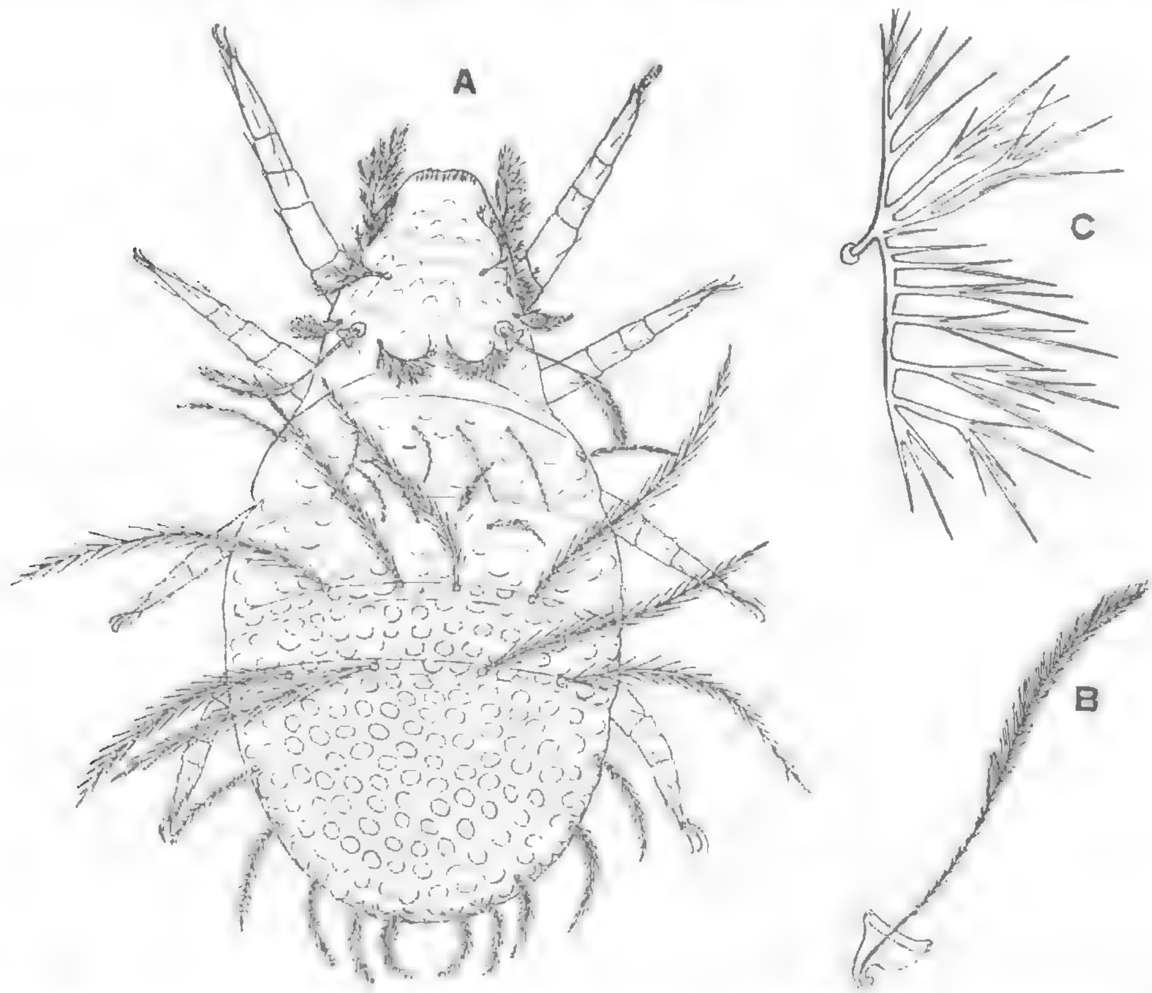

Fig. 2. *Cosmochthonius plumatus* v. *australicus* nov. A. dorsal view, B. pseudostigmal seta, C. lamellar seta.

strongly branched and aboriform, the lamellar hairs 48μ long are also doubly branched as in fig. 2C, the interlamellar hairs between sensillae bases are backwardly and inwardly curved. The first three divisions of the hysterosoma are narrow, the first with 4 finely ciliated setae 32μ long and a seta somewhat similar on each shoulder, the second division has 4 similar antero-median setae and the third and fourth divisions 4 long, 126μ and 110μ respectively, anterior ciliated setae with ciliations about 5 times as long as main stem is wide, the posterior division of the hysterosoma also with 10 submarginal and marginal setae as figured, 40–59μ long. Hysterosoma with many strongly impressed pits becoming weaker anteriorly.

Legs short, tarsi with 3 claws, of which the median (empodium) is stronger than the others.

Loc. Two specimens from moss from Mt. Arden, 12 miles north of Quorn, S. Aust., Nov., 43 (H. M. Cooper); also six specimens from debris from under tree ferns, Waterfall Gully, S. Aust., 5/35. (R.V.S.).

Remarks. In the structure of the hairs, particularly those on the cephalothorax, these specimens agree with Berlese's figure (loc. cit.) of *C. plumatus*, but Berlese states that his species differs from the genotype *C. lanatus* (Mich.) in the hysterosoma in the "cuticle not scabrous, reticulate or otherwise impressed." The South Australian specimens are definitely ornamented on the hysterosoma (cf. fig. 2A), but otherwise agree entirely in the structure of the hairs with Berlese's very fine detailed figure. In Michael's figure of *lanatus* (Brit. Orib. II, pl. XLIX, fig. 15), the hairs are shown as very different, especially the lamellar hairs, while the ciliations of the long hysterosomal hairs are scarcely longer than the width of the main stem.

It seems therefore that these specimens must be referred to a variety of Berleses' species with the dorsal cuticle having impressed pits.

AN INTERESTING AND PRIMITIVE NEW GENUS OF LAELAPTIDAE (ACARINA) FROM AUSTRALIA AND NEW GUINEA

By H. Womersley, A.L.S., F.R.E.S., Entomologist, South Australian Museum

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In 1938, Trägärdh (Entom. Tidskft, Hft. 3.4, p. 123) published his important paper "Further Contributions towards the Comparative Morphology and Classification of the Mesostigmata." In this paper he stressed the importance of the ventral shields of this group of Acarina, especially in the female sex, as affording valuable evidence of the relationship of the various genera.

In his view the four pairs of setae found on the jugular, sternal and metasternal shields indicate the coxal plates of the four pairs of legs. (It is generally accepted that the sternal shield in the Acarina is really formed by the fusion of coxal plates and that a true sternal shield does not occur). Generally in the Mesostigmata the sternal shield carries 2, 3 or 4 pairs of setae, mostly 3 pairs, the fourth pair often being found on the pair of small metasternal shields, as in Pergamasus and Macrocheles.

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In 1938, Trägårdh (Entom. Tidskft. Hft. 3.4, p. 123) published his important paper "Further Contributions towards the Comparative Morphology and Classification of the Mesostigmata." In this paper he stressed the importance of the ventral shields of this group of Acarina, especially in the female sex, as affording valuable evidence of the relationship of the various genera.

In his view the four pairs of setae found on the jugular, sternal and metasternal shields indicate the coxal plates of the four pairs of legs. (It is generally accepted that the sternal shield in the Acarina is really formed by the fusion of coxal plates and that a true sternal shield does not occur). Generally in the Mesostigmata the sternal shield carries 2, 3 or 4 pairs of setae, mostly 3 pairs, the fourth pair often being found on the pair of small metasternal shields, as in *Pergamasus* and *Macrocheles*.

In front of the sternal shield frequently occur 1 or 2 pairs of small shields, generally termed the jugular shields, one pair of which (posterior if 2 are present) often bear a pair of setae. If these carry a seta they are regarded by Trägårdh as representing the coxal plates of leg 1 and then it is found that the sternal shield bears only 2, or if the metasternal plates are fused with it, 3 pairs of setae. If the anterior pair of small plates do not bear setae, they are then considered as having nothing to do with leg 1, and are termed "pre-endopodal shields" by Trägårdh. In these cases the true coxal plates of leg 1 are fused with the sternal shield and their pair of setae are found thereon.

The new genus, with two species described in this paper, furnishes further evidence of Trägårdh's views, in that the sternal shield is longitudinally divided down the middle, each half carrying 3 setae with the corresponding pores. Each half therefore bears the setae corresponding to the coxal plates of legs I to III. The metasternal shields are wanting but are represented by the setae and their corresponding pores.

It appears evident, then, that the new genus, *Scissuralaelaps* is more primitive than any genus of the Mesostigmata or *Laelaptidae* so far known in that coalescence of the coxal plates in the medial line has not taken place.

FAMILY LAELAPTIDAE.

Genus SCISSURALAELAPS nov.

Description. *Hypoaspis*-like. Lightly chitinizied with moderately long to short fine dorsal setae. Female with sternal shield divided longitudinally, ventral shield fused with genital, widely separated from anal. Pre-endopodal shields present or absent. Meta-sternal shields only represented by seta and pore. Dorsal shield entire, not entirely covering body. Male with sternal, genito-ventral and shields coalesced. Legs without strong spines or processes. Mandible with process on movable finger of chelicerae.

Type *Scissuralaelaps nova-guinea* sp.n.

SCISSURALAELAPS NOVA-GUINEA sp. nov.

Fig. 1, A–G.

Description. Female. Oval in shape and well chitinized. Length (excluding gnathosoma) 675μ, width 405μ, gnathosoma 90μ. Dorsal shield as in fig. 1 A occupying about 5/6 of dorsum, with sparse, short, 7μ, setae. Epistome and chelicerae as figured. Palpi 5-segmented, V with bifurcate appendage. Legs

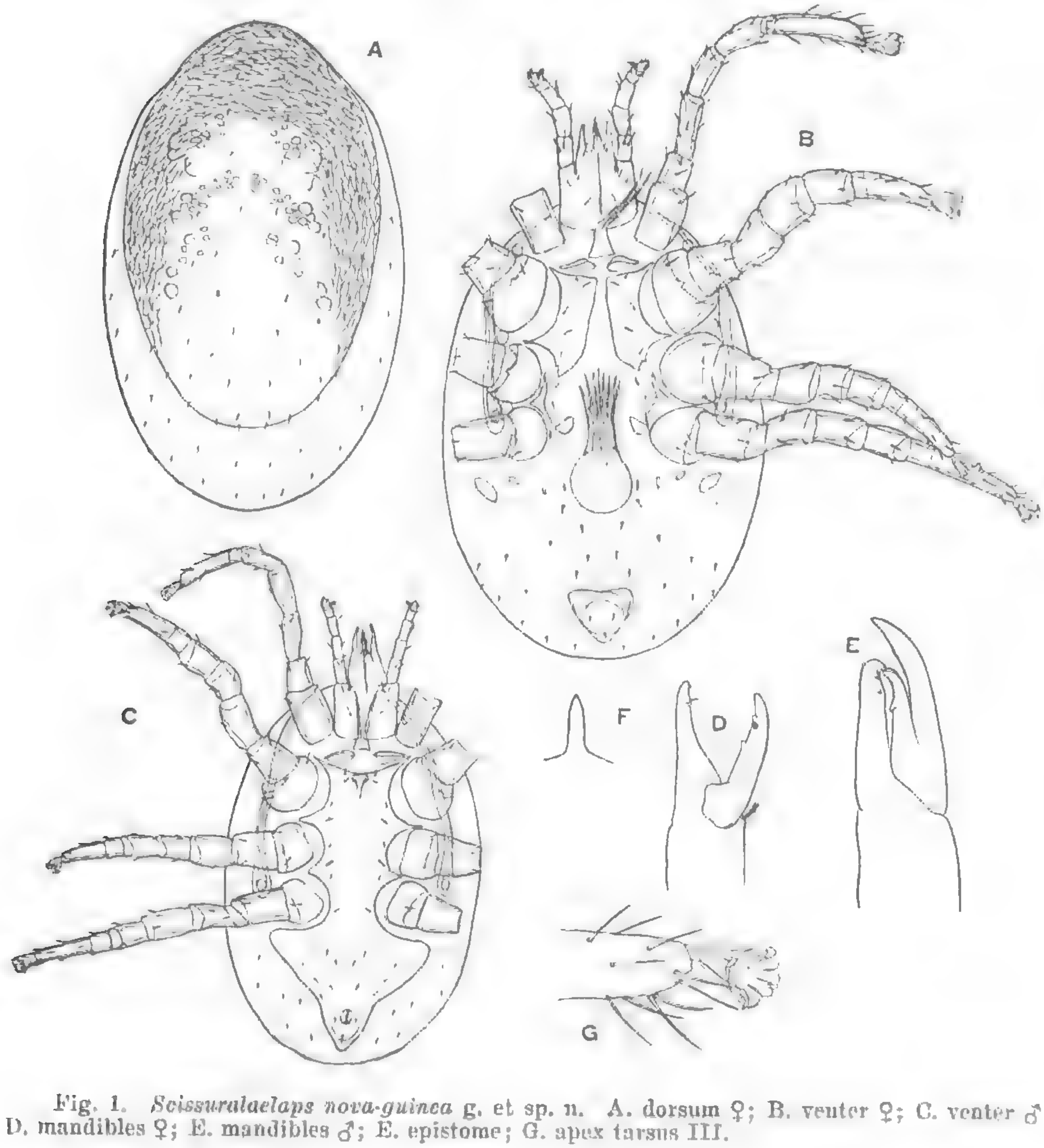

Fig. 1. *Scissuralaelaps nova-guinea* g. et sp. n. A. dorsum ♀; B. venter ♀; C. venter ♂; D. mandibles ♀; E. mandibles ♂; E. epistome; G. apex tarsus III.

relatively shorter and thicker than in following species, II stouter than the others. I 450μ long, II 375μ, III 430μ, IV 480μ, only furnished with normal setae; tarsi with caruncle and paired claws. Venter: pre-endopodal shields well defined (cf. fig. 1B); sternal shield completely divided longitudinally, each half with 3 setae and 2 pores; metasternal shields absent and only represented by the setae and

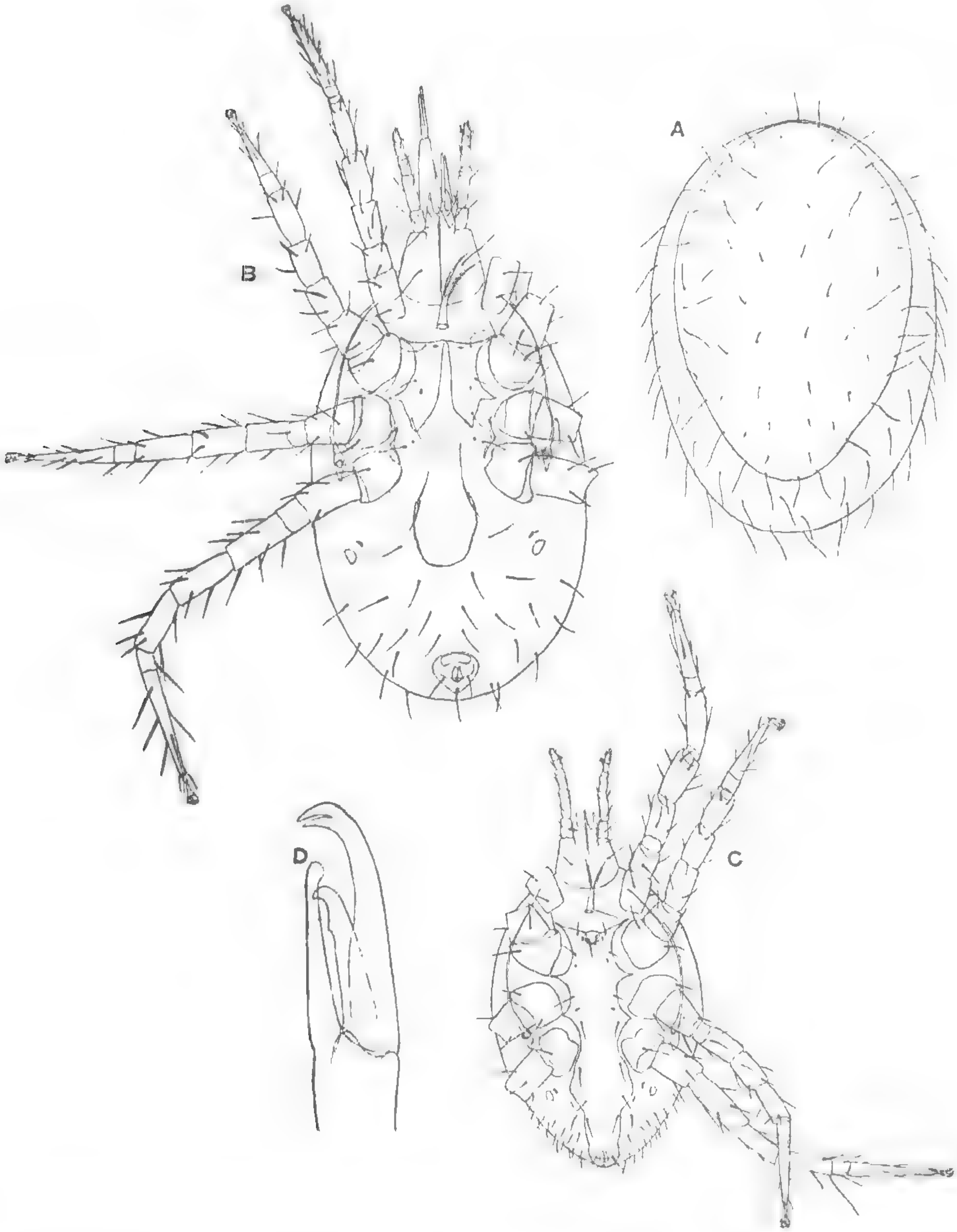

Fig. 2. *Scissuralaelaps queenslandica* sp. n. A. dorsum ♀; B. venter ♀; C. venter ♂; D. mandibles ♂.

pores; endopodal shields between coxae III and IV present; also on inside of coxae IV another rather triangular shield; genito-ventral shield as in fig. 1B with only a single pair of setae; behind coxae IV and on each side of genito-ventral is a somewhat oval shield and on inside of these two smaller shields; anal shield triangular with the usual 3 setae, and well separated from genito-ventral; ventral

setae short and fine. Gnathosoma with a pair of short simple setae. Peritreme long and slender.

Male, as in female, but length to 520μ, width 370μ, gnathosoma 150μ; dorsal shield occupying almost whole of dorsum. Chelicerae as in fig. 1E. All ventral shields coalesced except pre-endopodal; genito-ventral portion expanded widely behind coxae IV.

Loc. and *Host.* Described from 4 females and 1 male from a millipede on orchids from New Guinea and received at Burnley Gardens Research Station, Melbourne, 21.3.39 (R.T.M.P.).

Remarks. The primitive nature of this genus and species is discussed in the introduction.

SCISSURALAELAPS QUEENSLANDICA sp. nov.

Fig. 2 A–D.

Description. Female. Shape ovoid, well chitinized. Length (excluding gnathosoma) to 1,500μ, width 975μ, gnathosoma 300μ. Dorsal shield occupying about ⅚ of the dorsum, marginally with long fine simple setae to 150μ long, and on disc with short sparse setae to 40μ long. Epistome and chelicerae as in *S. nova-guinea*. Palpi as in genotype, V with bifurcate appendage. Legs relatively long and slender, without any thickening of II, I 1,200μ long, II 1,050μ, III 1,350μ, IV 1,700μ, only furnished with normal setae; tarsi with caruncle and paired claws. Venter; gnathosoma with a pair of simple setae; pre-endopodal shields practically wanting; sternal shield divided longitudinally except at extreme anterior margin, as in fig. 2B, each half with 3 setae and 2 pores, the setae about 70μ long; metasternal shields wanting and only represented by the setae and pores; endopodal shields between coxae III and IV present; genito-ventral shield as in fig. 2B, with only 1 pair of setae; on each side of genito-ventral shield and behind coxae IV is a small oval shield with a smaller crescent-like shield on its inside; anal shield, as in fig. 2B, well separated from genito-ventral. Peritreme long and slender.

Male. As in female but smaller, length 1,125μ, width 705μ, gnathosoma 220μ. Dorsal shield occupying almost the whole of dorsum. Legs I 1,200μ, II 1,050μ, III 1,200μ, IV 1,380μ, not differentiated from those of female. Venter: all shields except pre-endopodal coalesced as in fig. 2C; genito-ventral portion very much broadened behind coxae IV. Chelicerae as in fig. 2D.

Loc. Two males and one female from Bardon, Queensland, 1943 (N.B.T.).

Remarks. Differs from the genotype in the dorsal setae, the broadening behind coxae IV of the genito-ventral portion of the fused ventral plates of the male, in the relatively longer and thinner legs in both sexes, and in the coalescence of the coxal plates in the neighbourhood of leg I still being in evidence.

A CATALOGUE OF THE CONE SHELLS (CONIDAE) IN THE SOUTH AUSTRALIAN MUSEUM

By Bernard C. Cotton, Conchologist, South Australian Museum.

Summary

This catalogue is the result of a preliminary examination of the Conidae contained in the South Australian Museum cabinets and a few in other collections. The Museum cones are accumulated from the following sources.
1.Kenyon Collection. This magnificent series provides the bulk of material here reviewed and contains the few Brazier types. Although species are frequently represented by good series of typical specimens, most are, unfortunately, without locality. These series are referred to under localities as "Kenyon Collection." 2. Matthews Collection. 3. Verco Collection. 4. May Collection.
In addition the following people have donated or provided specimens for examination with localities: Dr. Deland, Manus; Miss K. Hammat, W. O. North; W. R. Steadman, Fiji; A. M. Lea, Lord Howe Island and Murray Island; N. B. Tindale, Groote Eylandt; H. K. Bartlett, Louisade Archipelago and East Coast New Guinea; also Mrs. L. A. Elliott, F. Trigg and others.

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Plates i–v, and Text Fig. 1.

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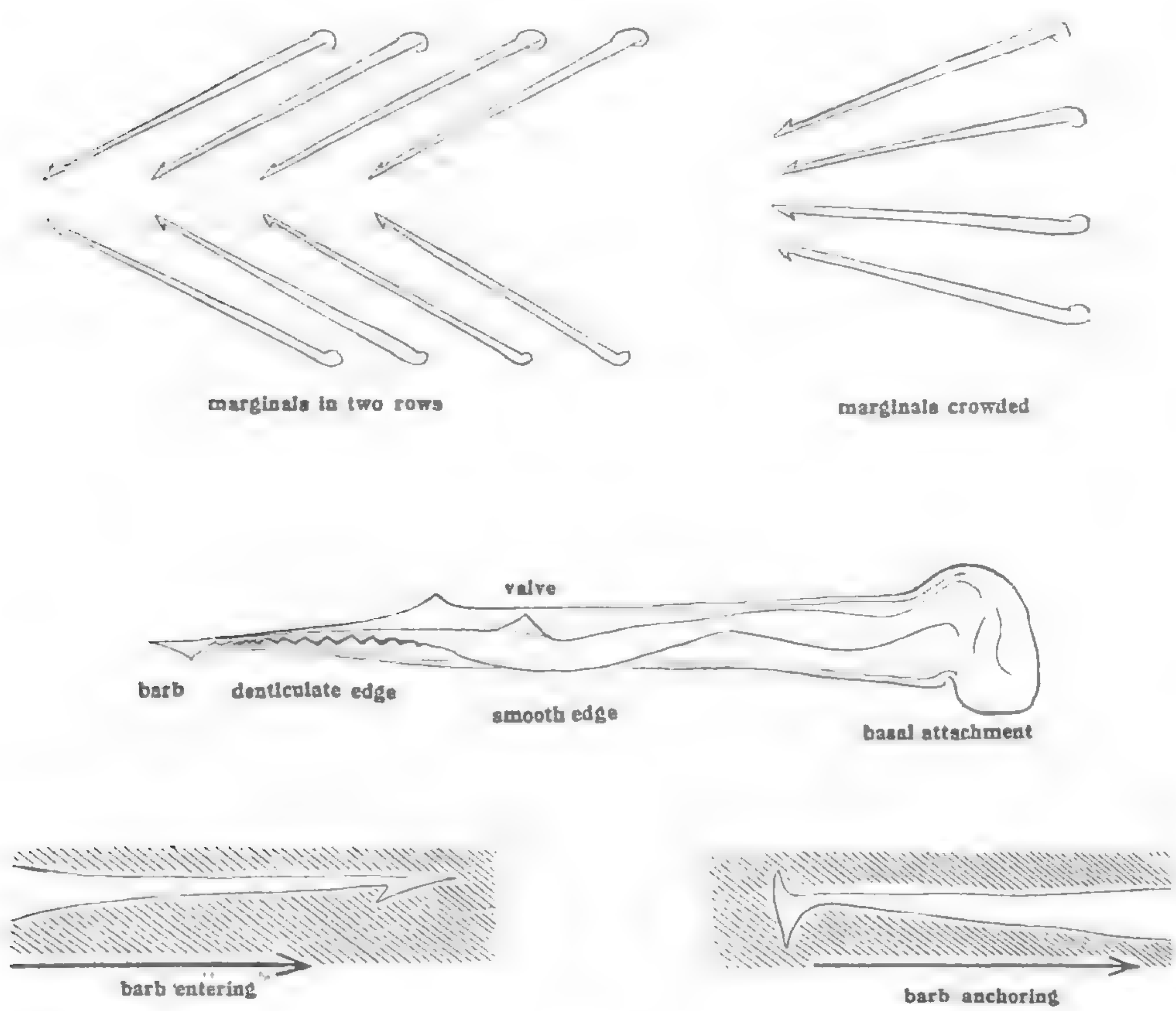
RADULA.

The following account of the radula of *Floraconus anemone* was made from a series of slides prepared from South Australian specimens. The dental formula is 1.0.0.0.1 and the microphotograph is of fully formed denticles. There are two rows of marginals, converging towards their points and behind them a sheaf or bundle not arranged in the double row. Each tooth tapers towards its distal extremity, where it ends in a crochet hook or single barb. From the base of the barb a toothed marginal ribbon extends half way along the denticle. The tooth is grooved along one surface up to the base of the barb so as to form an open, sheath like gutter. In this lies a ribbon, with teeth along the edge, attached distally to the base of the barb, and when not in use lying folded in the groove. The ribbon is continued to the base of the denticle, but with no teeth in its proximal half. The edge of the ribbon, entirely devoid of teeth is traceable to the expanded base of the denticle, and just opposite the point where the teeth cease and on the other edge of the ribbon is a sort of triangular stop, probably forming a valve. The edge of the ribbon which has the teeth, and which also extends to the base is loose and rumpled. In some specimens, and probably normally in all, the two edges of the ribbon are approximated. In all probability, when not in use, the rumpled edge of the ribbon lies loose and allows the denticulated edge to lie flat in the groove of the denticle, and when to be put into action, a muscle at the base pulls upon and straightens this edge and so makes taut and erect the denticulated half. This brings into position a row of denticulations continuous with the base of the barb. After erection the ribbon again folds longitudinally and with its free edges in contact forms a tube throughout the length of the denticle. The poison passing from the venom gland through a long duct opening into the oesophagus, thence to the teeth, finally traverses, probably by capillary attrac-

tion, the tube thus formed. The radula tooth of *Puncticulis arenatus* is apparently somewhat similar and *vexillum* also according to Peile 1939, 352, fig. 13.

References have been made to Cone Shells shooting or "spitting out" the denticles which bury themselves into the victim's flesh. This is unlikely. It seems more likely that the proboscis is extended, and the radula protruded, and the denticles quickly thrust into the flesh. Cumings, 42, described an attack by

DENTICLE OF FLORACONUS ANEMONE



Conus textile on an *Octopus* in an aquarium. He remarks, "When the radula is protruded, it is seen directly beneath the siphon." Clench and Kondo, 120, in describing the anatomy of *Conus striatus* state, "In the median crop or the narrow connecting tube was a well-preserved tooth of the *Conus* itself, which is without doubt the one used to kill the now partially digested prey." The proboscis in *Floraconus anemone* is well-provided with longitudinal and retractor muscles. The action of the barb in *Floraconus anemone* would then be, as suggested in the diagram, to enter and then anchor in the flesh. The barb catching would bend over the sharp point of the denticle at the narrow neck near the tip when the tooth would be torn from the radula at the base. Other species with the barbed points paired and opposite such as *Tulipuria tulipa*, *Darioconus textile*, *Parviconus rutilus* and *Dendroconus striatus* may

have a slightly different anchoring action. For comparison microphotographs of the denticles of *Darioconus omaria*, *Virgiconus lividus*, *Parviconus rutilus*, *Floraconus anemone* are reproduced. Mr. H. Brock of the Adelaide University kindly assisted me with the preparation of these photographs and also suggested the similarity of the *anemone* denticle to a whale harpoon. From this description it seems that the radula of *Floraconus anemone* is probably as venomous as any, though no fatalities have been recorded from Southern Australia. The animal usually withdraws rapidly into the shell when handled, which may account for the immunity enjoyed by many collectors who have handled them. Furthermore, it is doubtful whether a small cone of two or three inches in length has sufficient poison for a fatal dose, though it may be quite sufficient to paralyse smaller marine creatures. Known records of fatal bites have been from larger species of about four to six inches in shell height for the average specimen, such as *Rollus geographus* and *Darioconus textile*. As a wise precaution collectors will be well advised to pick up live specimens by the spire end of the shell, keeping the hand well away from the narrow or anterior end from which the proboscis projects.

Species actually recorded as having inflicted bites are *aulicus*, *textile*, *tulipa*, *marmoreus*, *geographus*.

CLASSIFICATION.

A preliminary attempt has been made to allot species to suitable genera, though it is realized that more genera will be required before a satisfactory classification can be offered. Genotypes are figured from specimens with definite localities. Principal synonyms and varietal names are listed under the respective species, but in this survey the species names are used in the wider sense and in some cases may represent groups of geographical subspecies. Tomlin, 1937, give a full list of specific names up to that date. Many more specimens remain in this collection to be examined and identified and may add considerably to this catalogue. The genus *Conella* Swainson (1840) genotype *Conus plicata* Swainson is now placed under the family *Columbellidae*.

The genera are here arranged in groups which may even represent subfamilies.

Group A. *Conus.*
Group B. *Coronaxis, Rhombus.*
Group C. *Virriconus, Puncticulis.*
Group D. *Stephanoconus, Chelyconus, Lautoconus.*
Group E. *Leptoconus, Dauciconus, Pionoconus.*
Group F. *Phasmaconus.*
Group G. *Rhizoconus, Virgiconus.*
Group H. *Rollus, Tuliparia.*
Group I. *Regiconus, Darioconus.*
Group J. *Cleobula, Textilia, Dendroconus.*
Group K. *Floraconus, Parviconus, Mamiconus.*
Group L. *Hermes, Leporiconus.*
Group M. *Asprella, Conasprella, Endemaconus.*
Group N. *Lovellona.*

GROUP A.

Genus CONUS Linné.

Conus Linné, 1758, p. 712.

Genotype: *Conus litteratus* Linné, 1758. Asiatico.

Lithoconus Mörch, 1853, p. 66.

Genotype: *Conus millepunctatus* Lamarck, 1822, Ocean Asiatique.

Cucullus Röding, 1798, p. 37.

Distribution. Indo-Pacific.

Remarks. Thiele (1929, p. 374) gave the generally accepted *marmoreus* Linne (1758) as genotype of the *Conus*, but Iredale (1930) pointed out that

Swainson (1840) gave the earliest type designation as *Conus litteratus* Linné (1758). Swainson actually refers to "*Conus* whose type is *C. litteratus*" whereas *marmoreus* is the first species described by Linné after the original description of the genus *Conus*. *Lithoconus* Mörch (1853, p. 66), is a synonym having for its genotype *millepunctatus*, so designated by Thiele (1929), and the first species listed under the genus by Mörch. *Cucullus* Röding (1798, p. 37), is without a definite genotype; the first species listed by the author was *imperialis*.

Conus litteratus Linné.

Conus litteratus Linné, 1758, p. 712. O. Asiatico.

Conus gruneri Reeve, 1844, Conch. Icon. 1, *Conus*, pl. 43, sp. 231. Java.

Loc. Manus. Rossel Island, Brooker Island, Fiji. Kenyon Collection. Queensland, Moreton Bay. Murray Island.

Remarks. Dr. Deland took a number of specimens of this large cone. There is a long series in the Kenyon Collection ranging up to 175 mm. in height and 122 mm. in diameter with a weight of 46 oz.

Conus millepunctatus Lamarck.

Conus millepunctatus Lamarck, 1822, p. 461. Ocean Asiatique.

Loc. Manus. Brooker Island. Moturina Island. Fiji. Queensland.

Remarks. This is separated with difficulty from the previous species. It is here taken to be the smaller form with separated black spots. The largest specimen taken in Fiji is only 41 mm. in height.

Conus eburneus Bruguière.

Conus eburneus Bruguière, 1792, p. 640. East Indies.

Conus polyglotta Weinkauff, 1874, p. 244. Pelew Island.

Loc. Manus. Fiji. Philippines. New Britain. Brooker Island. Moreton Bay, Queensland. New Caledonia. Java.

Conus thomae Gmelin.

Conus thomae Gmelin, 1791, p. 3394. In. Mari. Indico.

Conus omaicus Bruguière, 1792, p. 714. Oma Is., Indian Ocean.

Loc. Oma Island.

Remarks. There is a single specimen of this beautiful species.

Conus prometheus Bruguière.

Conus prometheus Bruguière, 1792, p. 667. African Ocean.

Loc. West Africa.

Conus tessulatus Born.

Conus tessulatus Born, 1780, p. 151. O. Africano.

Conus tessellatus Bruguière, 1792, p. 641. Hab.?

Loc. Indian Ocean. Mauritius. Seycheles. Kenyon Collection. Queensland. Torres Straits. New Britain. Manus. Misima. Brooker Island. Kyusta Island, Japan (Elliott).

CONUS CRASSUS Sowerby.

Conus crassus Sowerby, 1858, p. 25, pl. 12, fig. 254–255. Fiji.

Loc. Fiji.

Remarks. This small thick Fijian species seems quite distinct from typical *tessulatus.*

CONUS QUAESTOR Lamarck.

Conus quaestor Lamarck, 1810, p. 281. Hab.?

Conus muscosus Lamarck, 1810, p. 281. Hab.?

Conus paulina Kiener, 1850, p. 314, pl. 108, fig. 3. Hab.?

Conus masoni Nevill, 1874, p. 22. Andamans, 15 fathoms.

Loc. Kenyon Collection.

Remarks. One specimen, typical in colour and in the flat spire. Height 59 mm., diameter 39 mm.

CONUS PAPILIONACEUS Bruguière.

Conus papilionaceus Bruguière, 1792, p. 665. Indian Ocean and Coasts of Guinea.

Conus breviculus Sowerby, 1833, pt. 37, fig. 55. Hab.?

Loc. Kenyon Collection. "West Africa."

Remarks. One specimen, typical in colour and flat spire. Height 59 mm., dia meter 39 mm.

CONUS TROCHULUS Reeve.

Conus trochulus Reeve, 1844, pl. 45, sp. 246. Hab.?

Loc. Cape Verde Islands.

CONUS LORENZIANUS Dillwyn.

Conus phlogopus Tomlin, 1937, p. 206. New name for

Conus flammeus Lamarck, 1810, p. 279. Africa.

Conus lorenzianus Dillwyn, 1817, p. 370. East Indies.

Loc. West Coast Africa.

GROUP B.

Genus CORONAXIS Swainson.

Coronaxis Swainson, 1840, p. 147.

Genotype: *Conus marmoreus* Linné, 1758. Asia.

Remarks. At the above reference Swainson writes: "The mouth is a short proboscis (fig. 16, a), which in one genus (*Coronaxis* Sw.) has the margin simply circular, while in the other (*Conus* Linné) it is laciniated, or divided into a circular fringe of little points, analogous to the lips of the Trochidae." The figure 16 referred to shows the animal and shell of *Conus marmoreus* Linné and at *a* the proboscis and mouth On page 148 Swainson designates this species as type of *Coronaxis*. and *litteratus* as type of *Conus* Linné *s.s.* This genus includes the shells with chocolate, or pink reticulation, leaving rounded, triangular white spots.

CORONAXIS MARMOREUS (Linné).

Conus marmoreus Linné, 1758, p. 712. Asia.

Loc. Manus. Brooker Island. Port Moresby. Fiji. New Caledonia. Kenyon Coll. Torres Straits. Port Douglas. North Queensland. Barrier Reef.

Remarks. Manus specimens are small, about half the size of fully grown Indian Ocean specimens.

CORONAXIS PSEUDOMARMOREUS (Crosse).

Conus pseudomarmoreus Crosse, 1857, p. 223, pl. 9, fig. 4. Hab.?

Loc. New Caledonia.

Remarks. A single specimen is typical. The spire, not coronated, is one-fifth cf the height of the shell.

CORONAXIS CROSSEANUS (Bernardi).

Conus crosseanus Bernardi, 1861, p. 168, pl. 6, fig. 3, 4. New Caledonia.

Conus crosseanus lineata Crosse, 1878, p. 168, pl. 3, fig. 3, 3a. New Caledonia.

Loc. New Caledonia.

Remarks. Our specimens are smaller and more heavily marked with chocolate reticulations. Probably a variant of *marmoreus*.

CORONAXIS NIGRESCENS (Sowerby).

Conus nigrescens Sowerby, 1859, p. 429, pl. 49, fig. 2. Hab.?

Loc. New Guinea. Kenyon Collection. Manus.

Remarks. This form of *marmoreus* is smaller and even more heavily reticulated with brown. Typical ones can be selected from Manus material.

CORONAXIS NOCTURNUS (Solander).

Conus nocturnus Solander, 1786, p. 156, No. 3411. China.

Conus deburghiae Sowerby, 1858, p. 2, pl. 1, fig. 6, 7. Moluccas.

Loc. Moluccas.

Remarks. In our series from the above locality, one specimen is of the *deburghiae* variety, but apparently the same species.

CORONAXIS ARANEOSUS (Solander).

Conus araneosus Solander, 1786, p. 76, No. 1714; p. 106, No. 2328. Hab.?

Loc. Philippines.

Remarks. Kenyon series with the above locality range up to 70 mm. in height.

CORONAXIS NICOBARICUS (Bruguière).

Conus nicobaricus Bruguière, 1792, p. 612. Grandes Indes.

Conus peplum Sowerby, 1858, p. 3, pl. 1, fig. 13 and pl. 17, fig. 408. Red Sea.

Conus vidua Reeve, 1843, pl. 8, fig. 45. Capul.

Loc. Andaman Island. Nicobar.

Remarks. Specimens from the above localities appear distinct from *araneosus*.

CORONAXIS MARCHIONATUS (Hinds).

Conus marchionatus Hinds, 1843, p. 256. Marquesas.

Conus eudoxus Tryon, 1883, Man. Conch., p. 10, pl. 27, fig. 3. Hab.?

Loc. Marquesas Island.

Remarks. The species is represented by four adult typical specimens showing little variation.

CORONAXIS BANDANUS (Bruguière).

Conus bandanus Bruguière, 1792, p. 611. Banda Island.

Loc. Philippines. Banda Island. China Strait, Papua (Elliott).

Remarks. A Philippine Island specimen is 90 mm. in height.

Genus RHOMBUS Montfort.

Rhombus Montfort, 1810, 2, p. 403.

Genotype: *Conus imperialis* Linné, 1758. Hab.?

Remarks. Coronate shells with straight sides, interrupted spiral lines and sometimes a couple of irregular spiral bands.

RHOMBUS IMPERIALIS (Linné).

Conus imperialis Linné, 1758, p. 712. Hab.?

Conus fuscatus Born, 1780, p. 147. Mauritius.

Conus viridulus Lamarck, 1810, p. 31. Oc. Austral.

Loc. Brooker Island. Philippines. New Caledonia. Mauritius. Fiji.

RHOMBUS ZONATUS (Bruguière).

Conus zonatus Bruguière, 1792, p. 613. Ocean Asiatique.

Loc. Andaman Islland. Kenyon Collection.

Remarks. This appears to be distinct from *imperialis*.

GROUP C.

Genus VIRROCONUS Iredale.

Virroconus Iredale, 1930, p. 80.

Genotype: *Conus ebraeus* Linné, 1758. India.

Remarks. Shell short, wide and thick, spire a little coronated and rather elate; surface weakly spirally lirate, lirae coarser towards the base; typical colouration of semi-lunate to rectangular large black maculations forming three interrupted spiral bands on the body whorl, on a white background.

VIRROCONUS EBRAEUS (Linné).

Conus ebraeus Linné, 1758, p. 715. India.

Conus hebraeus Born, 1780, p. 159. Hab.?

Loc. Manus. New Britain. Lord Howe Island. Funafuti. Mauritius. Solomon Islands. Bougainville. Hawaii. Fiji. Misima. Queensland. Philippines.

Remarks. The Rev. H. K. Bartlett says that this species of cone and the Money Cowry *Monetaria moneta* are "the commonest objects on the beach at Misima."

VIRROCONUS CHALDAEUS (Bolten).

Cucullus chaldaeus Röding, 1798, *2*, p. 42. Hab.?

Conus vermiculatus Lamarck, 1810, p. 34. Seas of Asia.

Loc. Mauritius. Fiji. Lord Howe Island. Manus. Queensland.

Remarks. This species is distinguished from *ebraeus* by the vermiculate black colour pattern and the stronger sculpture.

VIRROCONUS CORONATUS (Gmelin).

Conus coronatus Gmelin, 1791, p. 3389. Hab.?

Conus miliaris Bruguière, 1792, p. 629. China.

Conus tiaratus Sowerby, 1833, pt. 25, fig. 10. Galapagos.

Conus abbreviatus Reeve, 1843, pl. 16, sp. 86. Sandwich Is.

Conus aristophanes Sowerby, 1858, fig. 81, 82. Sandwich Is.

Conus minimus Born, 1780, p. 156. In Indiis. Not *minimus* Linné, 1758.

Loc. Manus. Nila, Hawaii. Kenyon Collection. Fiji. Singapore, Philippines. Sandwich Islands. Northern Territory. Murray Island. North West Islet, Capricorn Group.

Remarks. A variable species. Our specimens of "*barbadensis*" from the West Indies are very like the variety "*aristophanes.*" Also recorded from Geraldton, Western Australia, Queensland, New South Wales.

VIRROCONUS CITRINUS (Gmelin).

Conus citrinus Gmelin, 1791, p. 3389. Curacas (Curacas, Venezuela). Not Kiener, 1849.

Conus mus Bruguière, 1792, p. 630. Guadeloupe, West Indies.

Conus barbadensis Bruguière, 1792, p. 632. Barbados, Guadeloupe and Santo Domingo.

Conus magellanicus Bruguière, 1792, p. 633. Martinique.

Conus jamaicensis Bruguière, 1792, p. 700. Jamaica.

Conus lubeckianus Bernardi, 1861, p. 169, pl. 6, fig. 7–8, Guadeloupe.

Conus minutus Reeve, 1864, pl. 47, fig. 259. St. Vincent. Not Röding, 1798, or Schröter, 1803.

Loc. Honduras. Florida. Bahamas. San Diego, California.

Remarks. Bruguière, 1792, p. 633 changed the type locality given by Favanne as Martinique to the Straits of Magellan which Clench, 1942, p. 7, points out was certainly in error.

VIRROCONUS PIPERATUS (Dillwyn).

Conus piperatus Dillwyn, 1817, p. 401. East Indies.

Conus punctatus Bruguière, 1792, p. 628. African Ocean. Not *punctatus* Gmelin, 1791.

Loc. West Africa. Sumatra.

VIRROCONUS MACULIFERUS (Sowerby).

Conus maculiferus Sowerby, 1833, pt. 29, fig. 23. Red Sea.

Loc. Red Sea.

VIRROCONUS ENCAUSTUS (Kiener).

Conus encaustus Kiener, 1846, p. 54, pl. 14, fig. 2. Hab.?

Loc. Marquesas. Kenyon Collection.

VIRROCONUS GENUANUS (Linné).

Conus genuanus Linné, 1758, p. 714. Hab.?

Conus taeniatus Bruguière, 1792, p. 628. North America, China.

Conus papilio Linné, 1767, p. 1168. Hab.?

Loc. Western Africa. Aden. Kenyon Collection.

VIRROCONUS CEYLANENSIS (Bruguière).

Conus ceylanensis Bruguière, 1792, p. 636. Ceylon.

Conus ceylonensis Dillwyn, 1817, p. 407, No. 100. Ceylon.

Conus nanus Sowerby, 1833, pt. 24, fig. 6. Lord Hood's Island.

Conus acutus Sowerby, 1858, p. 16, pl. 6, fig. 142. Ceylon.

Loc. Ceylon. Funafuti. Kenyon Collection.
Remarks. Recorded from Queensland.

VIRROCONUS SPONSALIS (Bruguière).

Conus nux Broderip, 1833, Proc. Zool. Soc., p. 54. Gallapagos.

Conus sponsalis Bruguière, 1792, p. 635. St. George Isles.

Loc. Gulf of California.

VIRROCONUS MUSICUS (Bruguière).

Conus musicus Bruguière, 1792, p. 629. China.

Conus mighelsi Kiener, 1850, p. 352. La mer des Indes.

Loc. Duke of York Group. East Cape, Papua. Manus. Fitzroy Island, Queensland.

VIRROCONUS PONTIFICALIS (Lamarck).

Conus pontificalis Lamarck, 1810, p. 38. (Tasmania) error.

Conus pontificalis Delessert, 1841, Recueil, pl. 40, fig. 15.

Loc. Broome. Geraldton. Carnarvon. Ellenbrook. Yallingup. Shark Bay.

Remarks. This Western Australian species was first incorrectly recorded from Tasmania, but later, and correctly listed by Hedley from Monte Bello Island. Exmouth Gulf. A large and typical specimen agreeing exactly with Delessert's figure, taken at Yallingup measures 39 mm. in height and 22 mm. in diameter.

Genus PUNCTICULIS Swainson.

Puncticulis Swainson, 1840, p. 311.

Genotype: *Conus arenatus* Bruguière, 1792. Philippines.

Remarks. Short, stout thick, somewhat swollen shells with numerous small spots and coronated spire.

PUNCTICULIS ARENATUS (Bruguière).

Conus arenatus Bruguière, 1792, p. 621. Philippines.

Conus mesokatharos Tryon, 1883, p. 18, pl. 27, fig. 2. Hab.?

Loc. Mauritius. Ceylon. Manus. Brooker Island. Fiji. New Caledonia. Torres Straits. Claremont Island. Philippines. Queensland. Claremont Islands.

Remarks. *Conus mesokatharos* is probably a juvenile of *arenatus*.

PUNCTICULIS ZEYLANICUS (Gmelin).

Conus zeylanicus Gmelin, 1791, p. 3389. Hab.?

Conus obesus Bruguière, 1792, p. 623. East Indies.

Loc. Ceylon. Kenyon Collection.

PUNCTICULIS STERCUS-MUSCARIUM (Linné).

Conus stercus-muscarium Linné, 1758, p. 715. Asia.

Loc. Manus. Misima. Brooker Island. Ceylon. North Australia. New Britain. Solomon Islands. Queenlsand.

PUNCTICULIS PULICARIUS (Bruguière).

Conus pulicarius Bruguière, 1792, p. 622. Pacific Ocean.

Conus fustigatus Bruguière, 1792, p. 623. Indian Ocean.

Loc. Brooker Island, Rossell Island. Anse Vata, New Caledonia. Queensland. Ceylon. Philippines.

PUNCTICULIS VAUTERI (Kiener).

Conus vauteri Kiener, 1850, p. 350, pl. 100, fig. 3. Hab.?

Loc. Marquesas Island. New Caledonia.

GROUP D.

Genus STEPHANOCONUS Mörch.

Stephanoconus Mörch, p. 65.

Genotype: *Conus nebulosus* Bruguière, 1792. Hab.? = *Conus regius* Gmelin, 1791. Hab.? Not *nebulosus* Gmelin, 1791.

Remarks. Shell thick, regularly conical, rather sharply angled at the shoulder, spire concavely elevated, tuberculate, closely spirally striate; typical colouration of a nebulous pattern, with a tendency to form bands.

STEPHANOCONUS REGIUS (Gmelin).

Conus regius Gmelin, 1791, p. 3379. Hab.?

Conus leucostictus Gmelin, 1791, p. 3388. Oceano americano.

Conus insularis Gmelin, 1791, p. 3389. Hab.?

Cucullus coronacivica Röding, 1798, p. 38. Hab.?

Conus cedonulli carrassaviensis Bruguière, 1792, p. 602. Curacao.

Conus cedonuli trinitarius Bruguière, 1792, p. 603. Trinidad.

Conus nebulosa Bruguière, 1792, p. 606. Hab.? Not *nebulosa* Gmelin, 1791.

Conus cedonulli martinicanus Bruguière, 1792, p. 603. Martinique.

Conus armillatus Adams, 1850, p. 59.

Conus cedonulli caracanus Bruguière, 1792, p. 603. Caracas (Venezuela).

Conus cedonulli grenadensis Bruguière, 1792, p. 603. Grenada.

Conus eques Bruguière, 1792, p. 705. Coast of Florida.

Loc. West Indies. Kenyon Collection. Barbados. Gulf of California.

Remarks. There are numerous varieties and subspecies in this complex species.

STEPHANOCONUS AURANTIUS (Bruguière).

Conus aurantius Bruguière, 1792, p. 606. Indian Ocean.

Loc. Moluccas. Amboina. Kenyon Collection.

STEPHANOCONUS VARIUS (Linné).

Conus varius, 1758, p. 715. Hab.?

Conus interruptus Wood, 1828, p. 8, pl. 3, fig. 2. Hab.?

Conus pulchellus Sowerby, 1834, pt. 54, fig. 61. Fremantle. Not *pulchellus* Swainson, 1822.

Conus hevassi Adams, 1853, p. 118. New name for *pulchellus* Sowerby.

Conus huassi Weinkauff, 1874, p. 252. Emend. for *hevassi.*

Loc. Broome, Shark Bay, Western Australia. Philippines. Moluccas. Fiji.

STEPHANOCONUS MOLUCCENSIS (Küster).

Conus moluccensis Küster, 1838, p. 121, pl. 23, fig. 4, 5. Moluccas.

Conus proximus Sowerby, 1859, p. 429, pl. 49, fig. 1. Hab.?

Conus pulcher Adams, 1854, p. 117, New Caledonia.

Conus stainforthii Reeve, 1843, pl. 1, sp. 1. Hab.?

Loc. Moluccas.

STEPHANOCONUS SUPERSCRIPTUS (Sowerby).

Conus superscriptus Sowerby, 1877, p. 753, pl. 75, fig. 4. Madagascar.

Loc. A single specimen probably from the type locality.

STEPHANOCONUS BRUNNEUS (Wood).

Conus brunneus Wood, 1828, p. 8, pl. 3, fig. 1. Hab.?

Conus diadema Sowerby, 1834, pt. 56–57, fig. 88. Hab.?

Loc. Galapagos Island. Changame Island, Panama Bay.

STEPHANOCONUS GLADIATOR (Broderip).

Conus gladiator Broderip, 1833, p. 55. Panama.

Loc. Kenyon Collection "West Coast of Central America." Panama.

STEPHANOCONUS PRINCEPS (Linné).

Conus princeps Linné, 1758, p. 713. Hab.?

Conus regius Bruguière, 1792, p. 617. Indian Ocean.

Conus lineolatus Valenciennes, 1832, p. 336. Acapulco.

Loc. San Francis-quito Island, Gulf of California.

Remarks. Typical examples of the "*regius*" variety with the wide longitudinal lines seem different from the fine lined "*lineolatus*" variety.

STEPHANOCONUS SUFFUSUS (Sowerby).

Conus suffusus Sowerby, 1870, p. 225, pl. 22, fig. 9. New Caledonia.

Conus noumeensis Crosse, 1872, *20*, p. 155. Noumea.

Loc. Kenyon Collection "New Caledonia."

Remarks. A series from "California" appear to be the same species. They are like a unicoloured "*lineolatus*." There is a Kenyon specimen labelled "Type specimen *Conus noumeensis* Brazier, Anse Vata, Noumea, New Caledonia." The label is attached to the specimen, but the shell has nothing to do with this species and is *chenui*.

STEPHANOCONUS CABRITTII (Bernardi).

Conus cabrittii Bernardi, 1858, p. 337, pl. 13, fig. 2. New Caledonia.

Conus taylorianus Smith, 1880, p. 480. Australia?

Loc. New Caledonia.

Genus CHELYCONUS Mörch.

Chelyconus Mörch, 1852, p. 9.

Genotype: *Conus testudinarius* Bruguière, 1792. Surinam. =*Conus ranunculus* Bruguière, 1792. American Ocean.

Remarks. Spire somewhat elevated, convex, striate, body whorl bulbous, spirally striate. The genotype is the first species listed by Mörch after the introduction of the genus.

CHELYCONUS RANUNCULUS (Bruguière).

Conus ranunuculus Bruguière, 1792, p. 671. American Ocean.

Conus testudinarius Bruguière, 1792, p. 694. Surinam (Dutch Guiana).

Conus informis Bruguière, 1792, p. 99. American Ocean. Not Reeve, 1843.

Conus portoricanus Bruguière, 1792, p. 714. Puerto Rico.

Conus puertoricanus Krebs, 1864, p. 6. West Indies. Error for *portoricanus*.

Conus barathrum Röding, 1798, p. 43. Hab.?

Conus flammeus Röding, 1798, p. 44. Hab.? Not Lamarck, 1810.

Conus narcissus Lamarck, 1810, p. 281. American Ocean.

Conus caerulescens Dillwyn, 1817, p. 368. St. Thomas. Not Schroter, 1803.

Conus caerulans Küster, 1838, p. 85, pl. 14, fig. 3–4. St. Thomas.

Conus aspersus Sowerby, 1933, pt. 28, fig. 16. Hab.?

Loc. West Indies. West Africa. Philippines. Cape Verde Islands. Manus.

CHELYCONUS PURPURASCENS (Sowerby).

Conus purpurascens Sowerby, 1833, pt. 25, fig. 13, 13x. Panama.

Conus regalitatis Sowerby, 1834, pt. 56, 57, fig. 87. Real Llejos.

Conus comptus Gould, 1853, pt. 387, pl. 14, fig. 23. Santa Barbara.

Loc. Panama. Perlas Islands.

Remarks. A specimen bearing the name *regalitatis* Sowerby belongs to the species *purpurascens,* of which it is apparently a synonym.

CHELYCONUS FULMEN (Reeve).

Conus fulmen Reeve, 1843, pl. 39, sp. 215. Capul.

Loc. Japan.

CHELYCONUS WORCESTERI (Brazier).

Conus (*Chelyconus*) *worcesteri* Brazier, 1891, p. 276, pl. 19, fig. 4. Island of Mauritius.

Loc. Mauritius.

Remarks. Holotype reg. no. D. 6178, S.A. Museum. The Kenyon label bears no locality though the specimen is certainly Brazier's holotype agreeing exactly with Brazier's figure. It is a perfect specimen with operculum and seems to bear some resemblance to *Chelyconus fulmen* Reeve.

CHELYCONUS CATUS (Bruguière).

Conus catus Bruguière, 1792, p. 707. Martinique.

Loc. Sandwich Island. Fiji. Manus. Tahiti. Kenyon Collection. St. Domingo, Martinique, and even Isle de France. Caloundra, Queensland.

CHELYCONUS ACHATINUS (Bruguière).

Conus achatinus Bruguière, 1792, p. 671. Indian Ocean.

Loc. Manus. New Hebrides. Ceylon. Fiji. Kenyon Collection. East Coast Papua. Brooker Island. Port Darwin, Fannie Bay, Bowen, North Australia, Melville Island.

CHELYCONUS MONACHUS (Linné).

Conus monachus Linné, 1758, p. 714. Hab.?

Conus superstriatus Sowerby, 1858, p. 37, pl. 13 (199), fig. 282. Hab.?

Loc. Kenyon Collection. Solomon Island. Loyalty Islands. Misima. Moluccas. Fiji.

Remarks. A specimen labelled *Conus superstriatus* in the Kenyon Collection is conspecific with *monachus.*

CHELYCONUS FROSTIANA (Brazier).

Conus frostiana Brazier, 1898, p. 781. Solomon Islands.

Loc. Solomon Islands.

Remarks. Holotype D. 6170. The specimen has the name locality and the words "type specimen" in Brazier's handwriting. It is a young specimen in all probability closely related if not synonymous with *monachus.*

CHELYCONUS BARBARA (Brazier).

Conus barbara Brazier, 1898. Solomon Islands.

Loc. Solomon Islands.
Remarks. Holotype D. 6176 from the Kenyon Collection. Probably a worn and damaged *monachus*.

CHELYCONUS CERINUS (Reeve).

Conus cerinus Reeve, 1848, pl. 3, sp. 283. Mindanao.

Loc. Philippines.
Remarks. Two typical specimens in the Kenyon Collection.

Genus LAUTOCONUS Monterosato.

Lautoconus Monterosato, 1923, p. 107.

Genotype: *Conus mediterraneus* Bruguière, 1792. Mediterranean.

Remarks. *Lautoconus* was introduced as a new section, but is here used generically.

LAUTOCONUS MEDITERRANEUS (Bruguière).

Conus mediterraneus Bruguière, 1792, p. 701. Mediterranean.

Loc. Mediterraneus. Kenyon Collection. Tangier.
Remarks. A great number of synonyms and varietal names are placed under this specific name, and many of them are represented in this collection.

GROUP E.

Genus LEPTOCONUS Swainson.

Leptoconus Swainson, 1840, p. 312.

Genotype: *Conus amadis* Gmelin, 1791. Hab.?

Remarks. Shell with spirally striate, channelled, concavely elevated, sharp pointed spire; shoulder angle sharp; lower part of body-whorl punctured, grooved.

LEPTOCONUS AMADIS (Gmelin).

Conus amadis Gmelin, 1791, p. 3388. Hab.?

Loc. Moluccas. Kenyon Collection. Java, Ceylon.

LEPTOCONUS AMMIRALIS (Linné).

Conus ammiralis Linné, 1758, p. 713. Oc. Americae Merid.

Loc. Moluccas. Kenyon Collection.
Remarks. There is a number of subspecies. East Indian, not West Atlantic. Fiji.

LEPTOCONUS AMMIRAIS TEMMES Iredale.

Leptoconus ammiralis temnes Iredale, 1930, p. 80. North West Isle, Capricorn Group.

Loc. North West Isle, Capricorn Group.
Remarks. One specimen taken by W. J. Kimber.

LEPTOCONUS ARCHITHALASSUS (Solander).

Conus archithalassus Solander, 1786, p. 189, no. 4017. Amboina.

Loc. Mauritius.

Remarks. This typical single specimen No. 42 of the Kenyon Collection approaches *temnes* Iredale in shape but has a different colour pattern. The name and locality on the label are Sowerby's, who probably supplied the shell.

LEPTOCONUS MONILE (Bruguière).

Conus monile Bruguière, 1792, p. 646. Indian Ocean.

Loc. Manus. Philippines. Ceylon.

LEPTOCONUS MALDIVUS (Bruguière).

Conus maldivus (Bruguière), 1792, p. 644. Maldive Island.

Loc. Ceylon. Maldive Island. Kenyon Collection.

Remarks. Colouration partaking somewhat of both *generalis* and *monile*.

LEPTOCONUS MALACANUS (Bruguière).

Conus malacanus Bruguière, 1792, p. 645. Straits of Malacca.

Loc. Malacca.

LEPTOCONUS SIEBALDI (Reeve).

Conus siebaldi Reeve, 1848, pl. 1, fig. 269. Japan.

Conus rarimaculatus Sowerby, 1870, p. 257, pl. 22, fig. 4. China Seas.

Loc. Kenyon Collection, "Japan."

LEPTOCONUS GENERALIS (Linné).

Conus generalis Linné, 1767, p. 1166. India Orientali.

Conus spirogloxus Deshayes, 1863, p. 135, pl. 8, fig. 13, 14. Reunion.

Loc. Manus. Moluccas. Fiji. New Caledonia. Brooker Island. Ceylon. Red Sea. Queensland, Darnley Island.

Remarks. South Pacific specimens are stouter with less bright and less contrasting colour pattern.

LEPTOCONUS THALASSIARCHUS (Sowerby).

Conus thalassiarchus Sowerby, 1834, pt. 56, 57, fig. 80, 85. Luzon.

Conus castrensis Gould, 1843, p. 138. Hab.?

Loc. Kenyon Collection "Philippines".

Remarks. In Gould's Otia Conchologica, 1862, there is in brackets the statement "This is the *C. thalassiarchus* Reeve, 1843," following the reprinted description of *castrensis* Gould.

LEPTOCONUS ACUMINATUS (Bruguière).

Conus acuminatus Bruguière, 1792, p. 688. Mers des grandes Indes.

Conus insignis Sowerby, 1833, pt. 28, fig. 17. Hab.?

Conus textilinus Kiener, 1850, p. 333, pl. 103, fig. 5. Hab.?

Conus nodulosus Sowerby, 1864. Swan River.

Loc. Red Sea.

Remarks. I have not recognized Sowerby's species amongst Western Australian shells.

LEPTOCONUS EMARGINATUS (Reeve).

Conus emarginatus Reeve, 1844, pl. 43, sp. 232. Pacific Ocean.

Conus arcuatus Gray, 1839, p. 119, pl. 36, fig. 22. Pacific Ocean, not *arcuatus* Broderip and Sowerby, 1829.

Conus clerii Reeve, 1844, pl. 43, fig. 229. Brazil.

Loc. Brazil.

Remarks. Differs from *clerii* only in the lack of striae on the upper portion of the body whorl and its more concave sides. *L. lentiginosus* is a narrow shell with more convex sides though it has been considered a variant by some.

LEPTOCONUS NOBILIS (Linné).

Conus nobilis Linné, 1758, p. 714. Hab.?

Conus cordigerus Sowerby, 1866, p. 329, pl. 21 (207), fig. 498. Philippines.

Conus victor Broderip, 1842, p. 54. Hab.?

Loc. Andaman Island.

LEPTOCONUS WEINKAUFFI (Lobbecke).

Conus weinkauffi Lobbecke, 1822, p. 90, figured op. cit., p. 188, pl. 4, fig. 1-3. New Caledonia.

Loc. New Caledonia.

LEPTOCONUS SPLENDIDULUS (Sowerby).

Conus splendidulus Sowerby, 1833, pt. 37, fig. 53. Indian Ocean.

Conus luctificus Reeve, 1848, pl. 2, sp. 280. Hab.?

Loc. Aden.

LEPTOCONUS FULMINEUS (Gmelin).

Conus fulmineus Gmelin, 1791, p. 3388. Hab.?

Conus fulgurans Bruguière, 1792, p. 687. Grandes Indes.

Conus eximius Reeve, 1849, pl. 4, sp. 256. Moluccas.

Loc. Queensland.

LEPTOCONUS LENTIGINOSUS (Reeve).

Conus lentiginosus Reeve, 1844, pl. 44, sp. 245. Hab.?

Loc. Bombay.

LEPTOCONUS CENTURIO (Born).

Conus centurio Born, 1780, p. 153, pl. 7, fig. 10. Hab.?

Loc. "West Indies," Kenyon Collection.

Remarks. Puerto Plata, Santo Domingo, was selected as type locality by Clench, 1944, p. 24.

LEPTOCONUS CANDIDUS (Kiener).

Conus candidus Kiener, 1848, p. 214, pl. 97, fig. 1. Hab.?

Conus floridensis Sowerby, 1870, 256, pl. 22, fig. 11. Florida.

Loc. Florida?

Remarks. Clench, 1944, p. 39, writes "This species has frequently been referred to as an earlier name for both *floridanus* Gabb and *pealii* Green. It may well be related, but is certainly not either of these species." I had previously allowed this species in my notes as a prior name for *floridanus*.

LEPTOCONUS STEARNSII (Conrad).

Conus stearnsii Conrad, 1869, p. 104, pl. 10, fig. 1. Florida.

Loc. Florida.

LEPTOCONUS TRAVERSIANUS (Smith).

Conus traversianus Smith, 1875, p. 107, text fig. Hab.?

Loc. Kenyon Collection. Aden.

Remarks. The Kenyon Collection specimens are smaller than the type, those from Aden adult and normal in size.

LEPTOCONUS JASPIDEUS (Gmelin).

Conus jaspideus Gmelin, 1791, p. 3387. Hab.?

Conus duvali Bernardi, 1862, p. 404, pl. 13, fig. 3. Guadeloupe.

Conus pusio Bruguière, 1792, p. 710. West Indies.

Conus pealii Green, 1830, p. 123, pl. 3, fig. 3. Key Vache (Vaca), Florida.

Conus acutimarginatus Sowerby, 1866, p. 328, pl. 288, fig. 640–641. Hab.?

Conus beddomei Sowerby, 1901, p. 101, pl. 9, fig. 1. West Indies.

Conus boubeeae Sowerby, 1903, p. 76, pl. 5, fig. 5. Hab.?

Loc. Venezuela.

LEPTOCONUS REGULARIS (Sowerby).

Conus regularis Sowerby, 1833, pt. 29, fig. 29. Central America and Panama.

Conus recurvus Broderip, 1833, p. 54. Monte Christi.

Conus syriacus Sowerby, 1833, pt. 36, fig. 45. Not Röding 1798.

Conus dispar Sowerby, 1933, pt. 37, fig. 57. Hab.?

Loc. Mazatlan. Panama.

LEPTOCONUS SPURIUS (Gmelin).

Conus spurius Gmelin, 1791, p. 3396. Hab.?

Conus proteus var. B., Bruguière, 1792, p. 682. Santo Domingo and Guadeloupe.

Conus leoninus Bruguière, 1792, p. 683. Mexico to Brazil. Not *leoninus* Gmelin, 1791.

Cucullus feruginеus Röding, 1798, p. 41. Hab.?

Cucullus syriacus Röding, 1798, p. 41. Hab.?

Cucullus quadratus Röding, 1798, p. 41. Hab.?

Conus ochraceus Lamarck, 1810, p. 275. Hab.?

Conus characteristicus Dillwyn, 1817, p. 367. St. Bartholomew.

Loc. Sanibel, Florida.

Genus DAUCICONUS nov.

Genotype: *Conus daucus* Bruguière, 1792. West Indies.

This genus is introduced for the species grouped around the *Conus daucus, ermineus, planorbis, vitulinus* series and may represent more than one genus. Shell straight sided, rather acutely angled at the shoulder; spire moderately elate and smooth; unicoloured, maculated or with interrupted banding; body whorl striate towards the base.

Remarks. Differing from *Leptoconus* in the shape of the spire, which is acute with straight sides and not peculiarly elongate at the tip as in that genus.

DAUCICONUS DAUCUS (Bruguière).

Conus daucus Bruguière, 1792, p. 651. West Indies.

Conus mamillaris Green, 1830, p. 123, pl. 3, fig. 6. Florida.

Conus daucus luteus Krebs, 1864, p. 4, *nom. nud.* West Indies.

Conus arausiensis "Chemnitz" Reeve, 1843, pl. 20, fig. 114. Sea of America.

Loc. West Indies.

DAUCICONUS ERMINEUS (Born).

Conus ermineus Born, 1780, p. 159. In Indiis.

Conus lithoglyphis Reeve, 1843, pl. 4, sp. 20. Ticao.

Conus lacinulatus Kiener, 1850, p. 312, pl. 108, fig. 2. Hab.?

Conus carpenteri Crosse, 1865, p. 302, pl. 9, fig. 1. New Guinea.

Loc. Ticao. Mauritius. Madagascar. Panavaravara Island. Kenyon Collection, "Philippines."

DAUCICONUS SUTOREANUS (Weinkauff).

Conus sutoreanus Weinkauff, 1875, p. 311, pl. 56, fig. 5, 6. Mauritius.

Loc. Loyalty Islands.

DAUCICONUS CIRCUMACTUS (Iredale).

Conus circumactus Iredale, 1929, p. 281, for *cinctus* Swainson.

Conus pulchellus Swainson, 1822, pl. 114. Amboyna. Not *pulchellus* Röding, 1798.

Conus cinctus Swainson, 1822, p. 110. Hab.? Not *cinctus* Bosc, 1801.

Loc. Philippines. Mauritius. Queensland.

DAUCICONUS CHENUI (Crosse).

Conus chenui Crosse, 1857, p. 381, pl. 11, fig. 3, 4. New Caledonia.

Conus loebbeckeanus Weinkauff, 1873, p. 221, pl. 36, fig. 3, 4. Hab.?

Loc. New Caledonia, Omida, Anse Vata, Noumea.

Remarks. Our specimens are typical and agree with the figures of both the above species.

DAUCICONUS VITULINUS (Bruguière).

Conus vitulinus Bruguière, 1792, p. 648. Indian Ocean.

Loc. Queensland. Philippines. Fiji. Kenyon Collection, "Ceylon." East Cape, east coast New Guinea.

DAUCICONUS PLANORBIS (Born).

Conus planorbis Born, 1780, p. 164, pl. 7, fig. 13, 14. Hab.?

Conus connectens Adams, 1854, p. 136. China.

Loc. Cambridge Gulf. Queensland. Fiji. Philippines. Indian Ocean.

Remarks. Specimens identified as *senator* Linné 1758 appear to be the same species. However, it is generally recognized that *senator* is unidentifiable. Linné described the species too briefly and without locality. There is no authentic figure. The species has been referred to *Rhizoconus* by some authors.

DAUCICONUS LINEATUS (Bruguière).

Conus lineatus Bruguière, 1792, p. 645. Indian Ocean.

Loc. Philippines. Queensland, Townsville. Fiji.

Remarks. Chemnitz and others have been quoted as authors of the above species. The name *notatus* Tomlin 1937 was introduced for *lineatus* Borson 1820, and there is a prior *lineatus* Solander 1766. The present species may require a new name.

DAUCICONUS FURVUS (Reeve).

Conus furvus Reeve, 1843, p. 13, sp. 69. Ticao.

Conus lignarius Reeve, 1843, pl. 24, sp. 136. Port Sacloban, Leyte Island.

Conus buxeus Reeve, 1844, pl. 47, sp. 265. Hab.? Not *buxeus* Röding 1798.

Conus cecilei Kiener, 1850, p. 286, pl. 98, fig. 4 and pl. 107, fig. 3. China Seas.

Loc. Philippines. Miri, Sarawak.

DAUCICONUS AUGUR (Solander).

Conus augur Solander, 1786, p. 44, No. 1046. Hab.?

Loc. Ceylon.

DAUCICONUS KERMADECENSIS (Iredale).

Conus kermadecensis Iredale 1913, p. 227, pl. 9, fig. 15, 16. Sunday Island.

Loc. Sunday Island, Kermadec Group.

Remarks. A specimen in this collection is marked "Type specimen Kenyon Coll. 420." It is a perfect specimen of this species but certainly not the type, and measures 45 mm. in length, not 55 mm. It apparently belongs to this genus and to the "*planorbis*" type.

Genus PIONOCONUS Mörch.

Pionoconus Mörch, 1852, p. 70.

Genotype: *Conus magus* Linné, 1758. Hab.?

Remarks. Shell with spire moderate in height, striate, body whorl long and rather cylindrical, closely striate below; clouded colouration.

PIONOCONUS MAGUS (Linné).

Conus magus Linné, 1758, p. 716. Hab.?

Conus circae Chemnitz, 1795, pl. 183, fig. 1778, 1779. Molucca Islands. Described by Sowerby 1858, p. 39, pl. 21, (207), fig. 513. 514, pl. 22, (208), fig. 525. Philippines.

Conus clandestinus Chemnitz, 1788, pl. 140, fig. 1296. Cited by Reeve 1849 p. 2, as a synonym of *magus*.

Conus indicus Chemnitz, 1788, pl. 140, fig. 1295, cited by Weinkauff 1874, p. 265, as var. of *magus*.

Conus tenellus Chemnitz, 1795, pl. 183, fig. 1782, 1783. Molucca Islands.

Conus raphanus Bruguière 1792, p. 722. Indian Ocean.

Conus carinatus Swainson, 1822, pl. 112, "Asiatic Ocean."

Conus ustulatus Reeve, 1844, sp. 239. New Holland.

Conus epistomium Reeve, 1844, sp. 227. Mauritius.

Conus epistomoides Weinkauff, 1875, Lief. 233, p. 315, pl. 57, fig. 5, 6. East Africa?

Conus striolatus Kiener, 1849, p. 266, pl. 105, fig. 1. Hab.?

Conus borneensis Sowerby, 1866, p. 239, pl. 28 (289), fig. 648. Borneo.

Conus frauenfeldi Crosse, 1865, p. 307, pl. 10, fig. 1, 1a. Madagascar.

Conus assimilis Adams, 1854, p. 118. Australia.

Conus consul Boivin, 1864, p. 33, pl. 1, fig. 5, 6. Hab.?

Conus lizardensis Crosse, 1865, p. 305, pl. 9, fig. 5. Lizard Island, North-East Australia.

Loc. Manus. East Cape, east coast New Guinea. Philippines. Caroline Islands. Queensland. Torres Straits. Broome. New Caledonia. Madagascar. Mapoon, Gulf of Carpentaria.

Remarks. Smith 1876 and later Tomlin 1937 misquoted *tenellus* Chemnitz 1795 as "*fenellus*". A long series bearing most of the above names as varieties is in our collection and they show a considerable but intergrading variation.

PIONOCONUS CONSORS (Sowerby).

Conus consors Sowerby, 1833, pt. 36, fig. 42. Philippines.

Conus anceps Adams, 1854, p. 119. Moluccas.

Conus innexus Adams, 1854, p. 118. Natal.

Conus daullei Crosse, 1858, p. 119, pl. 2, fig. 2, 2a. Mazotte.

Loc. Moluccas. Philippines. New Caledonia. Miri, Sarawak. Cambridge Gulf. Northern Territory. Singapore.

PIONOCONUS MERCATOR (Linné).

Conus mercator Linné, 1758, p. 715. Hab.?

Loc. Kenyon Collection. West Africa.

PIONOCONUS TIMORENSIS (Bruguière).

Conus timorensis Bruguière, 1792, p. 731. Grandes Indes.

Loc. Timor. Mauritius. East Cape, east coast of New Guinea.

PIONOCONUS INSCRIPTUS (Reeve).

Conus inscriptus Reeve, 1843, pl. 29, sp. 164. Hab.?

Conus keatii Sowerby, 1858, p. 34, pl. 20 (206), fig. 479. Seychelles.

Loc. Aden. Kenyon Collection.

PIONOCONUS SUTURATUS (Reeve).

Conus suturatus Reeve, 1844, pl. 45, sp. 250. Hab.?

Loc. Queensland.

PIONOCONUS PERTUSUS (Bruguière).

Conus pertusus Bruguière, 1792, p. 686. Grandes Indes.

Conus festivus Dillwyn, 1817, p. 413. Molluccas.

Conus amabilis Lamarck, 1810, Ann. du Mus. Hist. Nat. (Paris), 15, p. 425. Hab.?

Loc. Mauritius. Philippines.

PIONOCONUS JANUS (Bruguière).

Conus janus Bruguière, 1792, p. 690. Indian Ocean.

Loc. China. Seychelles Islands. Mauritius. Kenyon Collection.

PIONOCONUS ANDAMANENSIS (Smith).

Conus andamanensis Smith, 1878, p. 804, pl. 50, fig. 1, 1a. Port Blair.

Loc. Andaman Islands.

PIONOCONUS ERYTHRAENSIS (Reeve).

Conus erythraensis Reeve, pl. 24, sp. 137. Hab.?

Conus induratus Reeve, 1849, pl. 7, sp. 268. Red Sea.

Conus piperitus Reeve, 1844, pl. 43, sp. 230.

Conus dillwynii Reeve, 1849, p. 2. New name for *piperitus* Reeve, 1844. Not Dillwyn 1817.

Conus quadratomaculatus Sowerby, 1866, p. 328, pl. 27 (288), fig. 637, 638. Hab.?

Conus saphirostoma Weinkauff, 1074, p. 268. New name for

Conus coccineus Sowerby, 1866, p. 329, pl. 289 (28), fig. 646. Hab.?

Loc. Red Sea.

PIONOCONUS CINEREUS (Bruguière).

Conus cinereus Bruguière, 1792, p. 673. Indian Ocean.

Conus nisus Dillwyn, 1817, p. 388. Eastern Seas.

Conus zebra Lamarck, 1810, p. 273. Hab.?

Conus blandfordianus Crosse, 1867, p. 66, pl. 2, fig. 1. Hab.?

Conus stramineus Lamarck, 1810, p. 273. Hab.?

Conus alveolus Sowerby, 1833, pt. 25, fig. 11. Hab.?

Conus gabrielii Kiener, 1850, p. 315, pl. 74, fig. 4. Hab.?

Loc. Manus. Philippines. Solomon Islands. Moluccas. North-West Australia.

PIONOCONUS PUNCTICULATUS (Bruguière).

Conus puncticulatus Bruguière, 1792, p. 702. China and West Indies.

Conus perplexus Sowerby, 1858, p. 20, pl. 14 (200), fig. 324. Gulf of California.

Loc. California. Panama. La Libertad, Ecuador.

PIONOCONUS INTERRUPTUS (Broderip and Sowerby).

Conus interruptus Broderip and Sowerby, 1829, near Mazatlan.

Conus mahogani Reeve, 1843, pl. 22, sp. 126. Salango.

Loc. Panama. South California. Mazatlan. West Columbia.

PIONOCONUS MOZAMBICUS (Bruguière).

Conus mozambicus Bruguière, 1792, p. 696. Mozambique.

Conus macei Crosse, 1865, p. 309, pl. 10, fig. 5. Vizagapatam.

Loc. Kenyon Collection. Mozambique.

PIONOCONUS LYNCEUS (Sowerby).

Conus lynceus Sowerby, 1858, p. 37, pl. 19 (205), fig. 469. Moluccas.

Loc. Red Sea.

PIONOCONUS INFRENATUS (Reeve).

Conus infrenatus Reeve, 1848, pl. 3, sp. 285. Hab.?

Loc. Port Elizabeth, South Africa.

PIONOCONUS COLUMBA (Bruguière).

Conus columba Bruguière, 1792, p. 709. Asiatic Ocean and Mauritius.

Loc. East Indies.

Remarks. Clench, 1944, p. 39 writes "There appears to be nothing in the Western Atlantic that agrees with this species."

PIONOCONUS NEPTUNOIDES (Smith).

Conus neptunoides Smith, 1880, p. 479, pl. 48, fig. 2. Australia.

Loc. "Australia". New Caledonia, Noumea.

PIONOCONUS VIRGATUS (Reeve).

Conus virgatus Reeve, 1849, p. 1. Hab.?

Loc. Western Coast of Central America.

PIONOCONUS MISER (Boivin).

Conus miser Boivin, 1864, p. 39, pl. 1, fig. 9. Cape Vert.

Loc. Cape Verde Islands.

PIONOCONUS ALGOENSIS (Sowerby).

Conus algoensis Sowerby, 1834, pt. 54, fig. 65. Algoa Bay.

Loc. Algoa Bay, South Africa.

GROUP F.

Genus PHASMACONUS Mörch.

Phasmaconus Mörch, 1852, p. 70.

Genotype: *Conus radiatus* Gmelin, 1791. Hab.?

Remarks. Spire elevated, striate, acute; body whorl typically unicoloured and not spirally banded; lower part of body whorl distantly strongly grooved.

PHASMACONUS RADIATUS (Gmelin).

Conus radiatus Gmelin, 1791, p. 3386. Hab.?

Conus martinianus Reeve, 1844, pl. 40, sp. 217. Luzon.

Loc. Moluccas. Miri, Sarawak. Fiji. Queensland. New Britain.

PHASMACONUS PARIUS (Reeve).

Conus parius Reeve, 1844, pl. 43, sp. 235. Hab.?

Loc. Moluccas. Fiji.

Remarks. Typical from Moluccas. Philippines. Queensland.

PHASMACONUS LIENARDI (Bernardi and Crosse).

Conus lienardi Bernardi and Crosse, 1861, p. 49, pl. 1, fig. 2. New Caledonia.

Loc. New Caledonia. Kenyon Collection. Fiji.

PHASMACONUS OCHROLEUCUS (Gmelin).

Conus ochroleucus Gmelin, 1791, p. 3391. Hab.?

Loc. New Ireland. Moluccas. Fiji.

Remarks. Specimens are in the Kenyon Collection as "*Conus fasciatus* Martyn." Finlay 1926 introduced the name *Leptoconus jocus* for Martyn's species. Recorded from Swan River, Western Australia.

GROUP G.

RHIZOCONUS Mörch.

Rhizoconus Mörch, 1852, p. 68.

Genotype: *Conus vexillum* Gmelin, 1791. Hab.?

Remarks. Shell large, rather thin, spire striate; yellowish or chestnut with an irregular white central band.

RHIZOCONUS VEXILLUM (Gmelin).

Conus vexillum Gmelin, 1791, p. 3397. Amboina.

Conus robillardi Bernardi, 1858, p. 182, pl. 7, fig. 2, 3. Hab.?

Loc. Brooker Island. Manus. Kenyon Collection. New Caledonia. North Australia. Queensland. Fiji.

RHIZOCONUS SUMATRENSIS (Bruguière).

Conus sumatrensis Bruguière, 1792, p. 655. East Indies.

Loc. Sumatra.

RHIZOCONUS NAMOCANUS (Bruguière).

Conus namocanus Bruguière, 1792, p. 712. Namoca Island, Pacific.

Conus badius Kiener, 1847, p. 89, pl. 33, fig. 3. Hab.?

Conus laevigatus Sowerby, 1858, p. 27, pl. 7, fig. 149, 150 and pl. 9, fig. 207. Mauritius.

Loc. Philippines.

RHIZOCONUS CONCOLOR (Sowerby).

Conus concolor Sowerby, 1834, pt. 54, fig. 59. New name for
Conus unicolor Sowerby, 1834, pt. 28, fig. 58. India.

Loc. Kenyon Collection.

Remarks. Large, 120 mm. in height, unicoloured, chestnut, without colour bands.

RHIZOCONUS MILES (Linné).

Conus miles Linné, 1758, p. 713. India = Amboina.

Loc. Manus. Kenyon Collection. New Caledonia. Murray Island. North Australia. North-West Australia. East Coast Papua. Queensland. Fiji.

RHIZOCONUS CAPITANEUS (Linné).

Conus capitaneus Linné, 1758, p. 713. Asia.

Loc. Manus. West Indies. Hong Kong. Fitzroy Island, Queensland. Broome, North Australia. Torres Straits. Fiji. New South Wales.

RHIZOCONUS MUSTELINUS (Bruguière).

Conus mustelinus Bruguière, 1792, p. 654. Indian Ocean.
Conus sulphuratus Kiener, 1847, p. 130, pl. 66, fig. 3 and pl. 78, fig. 4. Hab.?

Loc. Philippines. Queensland. Fiji.

Remarks. Less distinctly banded than *capitaneus*. The species is regarded by Tryon 1884, 40, as a variety of *capitaineus*. He writes "The border-markings of the bands reduced to spots, the other revolving spots of the typical form absent. Clearly connected with the type by intermediate states."

RHIZOCONUS RATTUS (Bruguière).

Conus rattus Bruguière, 1792, p. 700. Mers d'Amerique.
Conus taitensis Bruguière, 1792, p. 713. Tahiti.
Conus viridis Sowerby, 1858, p. 20, pl. 5, fig. 102. Hab.?

Loc. New Hebrides. Tahiti. Kenyon Collection. Queensland. Fiji.

Remarks. Specimens in this collection from St. Francis Island, Corny Point, Daly Head, S.A., were identified by Hedley as "*Conus rattus*, a species common in the tropics, agree with a series from Fitzroy Island, Queensland." They are certainly not a *Floraconus*, but appear to be this species.

RHIZOCONUS CLASSARIUS (Bruguière).

Conus classarius Bruguière, 1792, p. 705. Indian Ocean.
Conus blainvilli Kiener, 1850, p. 358, pl. 111, fig. 1. Hab.?
Conus ruppelii Reeve, 1844, pl. 2, fig 273. Sea.
Conus pazii Bernardi, 1857, p. 385, pl. 11, fig. 1, 2. Hab.?

Loc. Aden. Kenyon Collection.

RHIZOCONUS ARGILLACEOUS (Perry).

Conus argillaceous Perry, 1811, pl. 24, No. 6. East Indies.

Loc. Berbera, East Africa. Aden.
Remarks. Probably a variant of *classarius.*

RHIZOCONUS TRIGONUS (Reeve).

Conus trigonus Reeve, 1848, pl. 3, fig. 286. Hab.?

Conus aureolus Sowerby, 1858, fig. 395. Hab.?

Loc. Philippines. Gulf of Carpentaria, Mapoon. Queensland. Broome.
Remarks. There is a series of somewhat smaller shells in the Kenyon Collection with spiral colour lines, but in other respects typical *trigonus*. They are without locality, but quite peculiar variants. The height of our largest *trigonus* is 80 mm. and of the variant 60 mm. Tryon and Reeve both figure a small specimen, but Weinkauff's figure of *trigonus* agrees well with our specimens in size, shape and colour.

RHIZOCONUS COFFEA (Gmelin).

Conus coffeae Gmelin, 1791, p. 3388. Hab.?

Conus coffea Weinkauff, 1874, p. 260. Emend. for *Coffeae* Gmelin.

Conus excavatus Sowerby, 1866, p. 326, pl. 25, fig. 616. Hab.?

Conus fumigatus Bruguière, 1792, p. 704, Mers d'Amerique.

Conus incarnatus Reeve, 1844, pl. 41, sp. 221. Malacca.

Loc. Manus. Red Sea. Kenyon Collection.

RHIZOCONUS VITTATUS (Bruguière).

Conus vittatus Bruguière, 1792, p. 704. Indian Ocean.

Conus orion Broderip, 1833, p. 55. Real Llejos.

Conus henoquei Bernardi, 1860, p. 380, pl. 13, fig. 4. Hab.?

Loc. Panama.

RHIZOCONUS SOPHIAE (Brazier).

Conus (*Rhizoconus*) *sophiae* Brazier, 1875, p. 7.

Loc. Hammond's or Bannietta Island, Solomon Archipelago, found on reef (Brazier).
Remarks. The type is not in the Kenyon Collection. The species is a doubtful one.

Genus VIRGICONUS gen. nov.

Genotype: *Conus virgo* Linné, 1758. Hab.?

Remarks. Shell rather narrow, sides straight, but little convex, shoulder angle well defined, body whorl slightly striate throughout, more distinctly at the base; unicoloured, tinged at the base with violet in typical species. The genus is introduced for the species allied to the *virgo, flavidus, lividus* series. Swainson, 1840, placed the type species under the typical genus *Conus*. Mörch, 1853, placed it under *Lithoconus* here regarded as a synonym of *Conus*. In the present genus the colour pattern is entirely different from the tessellated pattern of *Conus*.

VIRGICONUS VIRGO (Linné).

Conus virgo 1758, p. 713. Hab.? Amboina.

Conus emaciatus Reeve, 1849, pl. 5, sp. 248. Philippine Islands.

Loc. Aden. Kenyon Collection. Mauritius. Ceylon. Melville Island. Brooker Island. Manus. Philippines. Queensland. Fiji.

VIRGICONUS COELINAE (Crosse).

Conus coelinae Crosse, 1858, p. 117, pl. 2, fig. 1, New Caledonia.

Loc. Amede Island, New Caledonia.

Remarks. The specimen bearing this name is more delicate with straighter sides and more depressed spire than typical *virgo*. It is probably only a variety of that species.

VIRGICONUS FLAVIDUS (Lamarck).

Conus flavidus Lamarck, 1810, p. 265. Hab.?

Lithoconus peasei Brazier, 1877, p. 288. New name for

Conus neglectus Pease, 1861, p. 398. Sandwich Islands. Not *neglectus* Adams, 1854.

Loc. Brooker Island. Manus. Port Moresby. Kenyon Collection. Fiji. Funafuti. Darnley Island. Torres Straits. South Queensland.

VIRGICONUS LIVIDUS (Bruguière).

Conus lividus Bruguière, 1792, p. 630. East Indies.

Conus sanguinolentus Quoy and Gaimard, 1834, p. 99, pl. 53, fig. 18. Carteret, New Guinea.

Loc. Seychelles. Philippines. Manus. Red Sea. Queensland. Northern Territory. Fiji.

Remarks. The animal of *sanguinolentus* is described as bright red, whence the name, but the shells from New Guinea are indistinguishable from those of the East Indies, and Philippines. The present species is distinguished from *flavidus* by the livid colouration and coronate spire whorls. This species is of the *Virgiconus* rather than the *Stephanoconus* type.

VIRGICONUS SUGILLATUS (Reeve).

Conus sugillatus Reeve, 1844, pl. 45, sp. 247. Hab.?

Loc. Osumi, Japan. Queensland.

Remarks. Closely remembers *lividus* but brighter coloured and banded.

VIRGICONUS DISTANS (Bruguière).

Conus distans Bruguière, 1792, p. 634. Coast of New Zealand.

Loc. Tahiti. New Caledonia. Philippines. Kenyon Collection. Fiji.

VIRGICONUS WATERHOUSEAE (Brazier).

Conus waterhouseae Brazier, 1896, p. 471. Solomon Islands.

Loc. Solomon Islands.

Remarks. There are two specimens in the collection. The holotype reg. No. D. 5786 and another specimen marked "type of variety." The label covering

both specimens bears the inscription "Are they only variants of *C. distans* Hwass?", in Verco's handwriting. They both represent the one species, *waterhouseae*, which is distinct from *distans* in colouring, shape and stronger basal striae, and otherwise smooth and small shell.

VIRGICONUS ALBICANS (Sowerby).

Conus albicans Sowerby, 1858, p. 3, pl. 5 (191), fig. 98. Hab.?

Loc. Philippines.

VIRGICONUS BALTEATUS (Sowerby).

Conus balteatus Sowerby, 1833, pl. 37, fig. 58. Hab.?

Coronaxis cernicus Adams, 1869, p. 272, pl. 19, fig. 1. Barkly Island, Mauritius.

Loc. Mauritius.

VIRGICONUS KENYONAE (Brazier).

Conus kenyonae Brazier, 1896, p. 346, Sharks Bay.

Loc. Sharks Bay, Western Australia.

Remarks. The holotype is in this collection D. 14194. It probably belongs to this genus and the *distans* series. The specimen is worn and the colours faded, but the seven spiral grooves can be discerned.

VIRGICONUS ARROWSMITHENSIS (Brazier).

Conus kenyonae arrowsmithensis Brazier 1898, p. 346, fig. 4. Arrowsmith Island, Marshall Islands.

Loc. Arrowsmith Island.

Remarks. The holotype is in this collection D. 6177. It is a worn and bleached shell somewhat like *kenyonae* but with four distinct grooves on the body whorl, the posterior one slightly above the middle of the shell. The spire is similar but slightly more raised. In both this and *kenyonae* there are extra, less distinct spiral grooves at the anterior end.

GROUP II.

Genus ROLLUS Montfort.

Rollus Montfort, 1810, p. 395.

Genotype: *Conus geographus* Linné, 1758. In Indiis.

Remarks. Here belong the large, thin, inflated shells with faint revolving striae, coronate, striate spire and aperture widened anteriorly by the basally concave columella.

ROLLUS GEOGRAPHUS (Linné).

Conus geographus Linné, 1758, p. 718. In Indiis.

Conus mappa Crosse, 1858, 200, 205. New name for

Conus intermedius Reeve, 1843, pl. 23, sp. 129. Annaa Island. Not Lamarck 1810.

Loc. Manus. Brooker Island. Panavaravara Island. Kenyon Collection. North Queensland. Fiji.

Remarks. Australian specimens measure up to 145 mm. in height and 65 mm. in diameter.

ROLLUS OBSCURUS (Sowerby).

Conus obscurus Sowerby, pt. 29, fig. 26. Arabia.

Loc. Philippines. Solomons. Mauritius.

Genus TULIPARIA Swainson.

Tuliparia Swainson, 1840, p. 147.

Genotype: *Conus tulipa* Linné, 1758. Hab.?

Remarks: This genus is closely allied to *Rollus*. Shell with spire scarcely coronate, body whorl smooth and slightly swollen, colouration of spiral chestnut and white articulations.

TULIPARIA TULIPA (Linné).

Conus tulipa Linné, 1758, p. 717. Hab.?

Loc. Brooker Island. Manus. Fiji. New Hebrides. North Queensland. New Caledonia.

TULIPARIA BORBONICUS (Adams).

Conus borbonicus Adams, 1868, p. 288, pl. 28, fig. 1. Isle of Bourbon.

Loc. Loyalty Islands, Lifou. Fiji, Suva.

Remarks. This has been regarded as a juvenile of *tulipa* by some authors and described as a *Chelyconus* by others. The half dozen shells in our collection are all small and typical of the species.

GROUP I.

Genus REGICONUS Iredale.

Regiconus Iredale, 1930, p. 79.

Genotype: *Conus auratus* Bruguiere, 1792. Indian Ocean.

Remarks. This genus includes the large narrow shells with elevated spire and large subtriangular white spots. This genus seems very closely allied to *Darioconus* judging from the genotypes.

REGICONUS AURATUS (Bruguière).

Conus auratus Bruguière, 1792, p. 740. Indian Ocean.

Loc. Philippines. "Indo-Pacific."

Remarks. According to our specimens the only distinguishing features from *aulica* are the narrower, more cylindrical shape and finer colour pattern of *auratus*. The two species seem closely allied. The genotype species is represented in our collection by only one specimen from the Philippines which could be regarded as typical of the figure given by Reeve, 1843, pl. 25, fig. 141a.

REGICONUS AULICUS (Linné).

Conus aulicus Linné, 1758, p. 717. Asia.

Loc. Brooker Island. Fiji. Kenyon Collection. Ceylon. Rossell Island. New Caledonia. Solomon Islands.

Genus Darioconus Iredale.

Darioconus Iredale, 1930, pt. 1, p. 79.

Genotype: *Conus omaria* Bruguière, 1792. Indian Ocean.

Cylinder Montfort, 1810, p. 407.

Genotype: *Conus textile* Linné, 1758. Ad Bandam Asiae. Not *Cylindra* Illiger, 1802.

Remarks. There seems to be little difference between this genus and *Regiconus* Iredale, 1930. It is here used for the bulk of the species belonging to the well known and extensive group related to the textile type distinguished by the characteristic colour pattern.

Darioconus omaria (Bruguière).

Conus omaria Bruguière, 1792, p. 743. l'Ocean Asiatique, Madagascar, Manille.

Conus praelatus Bruguière, 1792, p. 746. Grandes Indes.

Conus episcopus Bruguière, 1792, p. 748. Grandes Indes.

Conus rubiginosus Bruguière, 1792, p. 744. East Indies.

Conus magnificus Reeve, 1843, pl. 6, sp. 32. Matnog, Island of Luzon, Philippines.

Loc. Murray Island. Bowen. Caloundra, Queensland. Torres Straits. Gladstone. Misima. Brooker Island. Manus. New Hebrides. Kenyon Collection. Fiji, Loma Loma.

Remarks. Our extensive series suggest that the above names are all applicable to one species.

Darioconus racemosus (Sowerby).

Conus racemosus Sowerby, 1874, p. 721, pl. 59, fig. 11. Sandwich Islands.

Loc. Kenyon Collection.

Remarks. One specimen, typical.

Darioconus pennaceus (Born).

Conus pennaceus Born, 1780, p. 167, pl. 7, fig. 15. China.

Loc. Mauritius. Philippines. Kenyon Collection. Fiji. Darnley Island.

Remarks. Our specimens are distinguished by the wide shell and large white subtrigonal colour spots.

Darioconus textile (Linné).

Conus textile Linné, 1758, p. 717. Ad Bandam Asiae.

Conus vicarius Lamarck, 1810, p. 274. Hab.? Asia?

Conus scriptus Sowerby, 1858, p. 41, pl. 23 (209), fig. 563. Hab.?

Conus tigrinus Sowerby, 1858, p. 41, pl. 23 (209), fig. 569. Madagascar.

Loc. Moturina Island. Manus. Port Moresby. Brooker Island. Fiji. North Australia. Kenyon Collection. Murray Island. Connexion Island. Townsville. Thursday Island. Groote Eylandt. Port Keats. Port Douglas. North-West Australia.

DARIOCONUS VICTORIAE (Reeve).

Conus victoriae Reeve, 1843, pl. 37, sp. 202. Mouth of the Victoriae River, New Holland.

Conus complanatus Sowerby, 1866, p. 330, pl. 28 (289), fig. 650, 651. Australia.

Loc. Western Australia. Broome. Kenyon Collection.

Remarks. The colouration of light coloured reticulation and darker bands distinguish this species.

DARIOCONUS STELLATUS (Kiener).

Conus stellatus Kiener, 1849, p. 225, pl. 99, fig. 3. Hab.?

Conus elisae Kiener, 1849, p. 341, pl. 64, fig. 1, 1a. Hab.?

Loc. Madagascar.

DARIOCONUS ABBAS (Bruguière).

Conus abbas Bruguière, 1792, p. 750.

Loc. Ceylon. Kenyon Collection.

DARIOCONUS PANNICULUS (Lamarck).

Conus panniculus Lamarck, 1810, p. 435. Mers de Grandes Indes.

Conus corbula Sowerby, 1858, p. 42, pl. 23 (209), fig. 573. Hab.?

Conus dalli Stearns, 1873, p. 78, pl. 1, fig. 1. Gulf of California.

Loc. Marquesas. New Hebrides. Ceylon.

DARIOCONUS AUREUS (Bruguière).

Conus aureus Bruguière, 1792, p. 742. China.

Loc. Moluccas. New Caledonia. Fiji.

DARIOCONUS ARCHIEPISCOPUS (Bruguière).

Conus archiepiscopus Bruguière, 1792, p. 747. Grandes Indes.

Conus canonicus Bruguière, 1792, p. 749. Grandes Indes.

Conus rubescens Schroter, 1803, p. 73. Hab.?

Conus legatus Lamarck, 1810, p. 437, Mers. des Grandes Indes.

Conus madagascariensis Sowerby, 1858, p. 43, pl. 210 (24), fig. 582. Madagascar.

Loc. New Britain. Philippines. Queensland. Rossell Island.

DARIOCONUS PAULUCCIAE (Sowerby).

Conus paulucciae Sowerby, 1876, p. 752, pl. 75, fig. 3. Mauritius.

Loc. Mauritius.

DARIOCONUS RETIFER (Menke).

Conus retifer Menke, 1829, p. 68. Hab.?

Conus solidus Sowerby, 1834, pt. 56, p. 57 (large list), No. 76. New name for

Conus textile sulcata Sowerby, 1834, pts. 56-57, fig. 76. Not *sulcatus* Bruguière, 1792.

Loc. Japan, Oshima. Kenyon Collection.

DARIOCONUS MARMORICOLOR (Melvill).

Conus omaria var. *marmoricolor* Melvill, 1900, p. 310. Hab.?

Loc. Hawaiian Islands. Kenyon Collection.

Remarks. Our specimens are quite distinctive. The body whorl is a little swollen and the colour pattern recalls that of *marmoreus* in the shape of the subtrigonal, white spots. The spire and shape of the shell generally are otherwise typical of *Darioconus*.

DARIOCONUS CHOLMONDELEYI (Melvill).

Conus cholmondeleyi Melvill, 1900, p. 308, fig. in text. Hab.?

Loc. Kenyon Collection. Manus.

Remarks. Two specimens in the Kenyon Collection bear this name. From the Manus material I picked out an example which agrees with the type figure in all respects save that the colour pattern is slightly coarser.

DARIOCONUS VERRICULUM (Reeve).

Conus verriculum Reeve, 1843, pl. 38, sp. 208. Ceylon.

Loc. Mauritius.

Remarks. Short and broad, white subtrigonal; spots large.

DARIOCONUS LUCIDUS (Wood).

Conus lucidus Wood, 1828, p. 8, pl. 3, fig. 4. South Sea.

Loc. West Coast of Central America.

DARIOCONUS TEXTILIS OSULLIVANI (Iredale).

Dariconous textilis osullivani Iredale, 1931, p. 224, pl. 25, fig. 13. Black Rock, Richmond River, New South Wales.

Loc. Northern New South Wales.

Remarks. Our specimen was with shells said to have come from Byron Bay.

GROUP J.

Genus CLEOBULA Iredale.

Cleobula Iredale, 1930, p. 79.

Genotype: *Conus figulinus* Linné, 1758. Hab.?

Remarks. This genus includes the thick pyriform shells with fine, spiral colour lines.

CLEOBULA FIGULINA (Linné).

Conus figulinus Linné, 1758, p. 715. Hab.?

Conus loroisii Kiener, 1847, p. 91, pl. 65, fig. 1. Mer de l'Inde.

Conus figulinus chytreus Tryon, 1883, p. 17, pl. 27, fig. 1. Hab.?

Loc. Manus. New Britain. Ceylon. Fiji. Diego Garcia. Port Douglas, Queensland. Port Moresby.

CLEOBULA BETULINA (Linné).

Conus betulinus Linné, 1758, p. 715. Hab.?

Loc. Ceylon. Madagascar. Manus. Kenyon Collection.

Remarks. A large shell 166 mm. in height and 115 mm. in diameter, weighs 36 oz.

CLEOBULA GLAUCA (Linné).

Conus glaucus Linné, 1758, p. 714. Asia.

Conus scalptus Reeve, 1843, pl. 37, sp. 203. Hab.?

Loc. Manus. Philippines. New Britain.

Remarks. Recorded from Queensland. A specimen bearing the name "*scalptus*" is a juvenile of *glaucus* where Reeve's species probably belongs. It is without locality.

CLEOBULA QUERCINA (Solander).

Conus quercinus Solander, 1786, p. 67, No. 1501. Hab.?

Conus quercinus Bruguière, 1792, p.

Loc. New Caledonia. Fiji. Manus. Kenyon Collection, Pacific Islands. Ceylon. Philippines. Brooker Island. Western Australia, Albany.

Remarks. Four large specimens measuring up to 102 mm. in length taken amongst weed in sandy depressions at Suva, Fiji, by W. R. Steadman, have an anterior oblique fold on the columella, and the anterior end of the aperture is tinged with pink within; they are old specimens with coroded spires recalling the "*ponderosa*" Sowerby, 1858. New Caledonian shells are 74 mm. and 73 mm. in height. In the juvenile the species may be easily mistaken from its slender shape for one of the *virgo* group but for the spiral colour lines of *Cleobula*.

CLEOBULA CALIFORNICA (Reeve).

Conus californica Reeve, 1844, pl. 42, sp. 224. California.

Conus dealbatus Adams, 1854, p. 117. Hab.?

CLEOBULA SURATENSIS (Bruguière).

Conus suratensis Bruguière, 1792, p. 669. Grandes Indes.

Loc. Philippines.

CLEOBULA PATRICUS (Hinds).

Conus patricus Hinds, 1843, p. 256 (April). Gulf of Nicoya.

Conus pyriformis Reeve, 1843, pl. 13, sp. 70 (May). Bay of Caraccas and Montifa.

Loc. San Marcus Island. Gulf of California.

Genus DENDROCONUS Swainson.

Dendroconus Swainson, 1840, p. 311.

Genotype: *Conus striatus* Linné, 1758. Versus littora Hitae.

Strioconus Thiele, 1929, p. 374. Same genotype.

Remarks. In this genus are placed shells with close spiral striae, and spire whorls channelled, carinate and striate.

DENDROCONUS STRIATUS (Linné).

Conus striatus Linné, 1758, p. 7166. Versus littora Hitae.

Loc. Manus. Brooker Island. Kenyon Collection. Murray Island. Queensland. North-West Australia, Pt. Headland. Caloundra. Torres Straits. Northern Territory. Ceylon. Loma Loma, Fiji.

Remarks. Numerous specimens from Manus up to 80 mm. in height.

DENDROCONUS GUBERNATOR (Bruguière).

Conus gubernator Bruguière, 1792, p. 727. Indian Ocean.

Conus termineus Lamarck, 1810, p. 426. Asia.

Loc. Ceylon. East Indies. Fiji. Philippines. Manus. Brooker Island.

Remarks. There seems to be a larger form which we have from Ceylon as *gubernator* and a smaller form well represented in the Pacific which is labelled *termineus* in our collection. Both species have been recorded from Ceylon and are considered to be synonyms by Tryon.

Genus TEXTILIA Swainson.

Textilia Swainson, 1840, p. 312.

Genotype: *Conus bullatus* Linné, 1758. Hab.?

Remarks. Thick, polished, swollen whorls, smooth above, grooved below and spire whorls striate.

TEXTILIA BULLATA (Linné).

Conus bullatus Linné, 1758, p. 717. Hab.?

Loc. Manus. Philippines. Kenyon Collection.

TEXTILIA CERVA (Lamarck).

Conus cervus Lamarck, 1822, 7, p. 510. Hab.?

Loc. Moluccas.

Remarks. Our largest specimen is 70 mm. in height.

TEXTILIA TINIANA (Bruguière).

Conus tinianus Bruguière, 1792, p. 713. Tinian Island.

Conus aurora Lamarck, 1810, p. 423. Hab.?

Conus scutor Hedley, 1913, p. 308. Error for

Conus secutor Crosse, 1865, p. 303, pl. 9, fig. 3. Hab.?

Conus rosaceus Dillwyn, 1817, p. 433. East Indies.

Conus loveni Krauss, 1848, p. 131, pl. 6, fig. 25.

Conus lavendulus Bartsch, 1915, p. 12, pl. 1, fig. 12. S. Africa, Cape and Natal.

Loc. Kenyon Collection. Tinian Island. Cape of Good Hope, S. Africa.

Remarks. We have this species from Krysna, South Africa as *lavendulus*.

TEXTILIA ADAMSONI (Broderip).

Conus adamsoni Broderip, 1836, p. 44. Hab.?

Conus rhododendron Jay, 1839, p. 100, No. 3805, pl. 7, fig. 2, 3. Australasia.

Conus cingulatus Sowerby, 1825, No. 2467, p. 34, not Lamarck, 1810.

Conus discrepans Sowerby, 1833, pt. 29, fig. 28. Hab.?

Loc. Kenyon Collection. Claremont Islands.

Remarks. A series of this beautiful shell is without definite locality. One specimen has the label "*adamsonii*, Claremont Is."

TEXTILIA CUVIERI (Crosse).

Conus cuvieri Crosse, 1858, p. 123. New name for

Conus deshayesii Reeve, 1843, pl. v, sp. 28. Swan River.

Loc. Aden.

Remarks. Our specimens from Aden are typical. It is probably not a Western Australian shell, though it is also recorded from Queensland.

TEXTILIA STILLATA (Reeve).

Conus stillatus Reeve, 1849, pl. 5, sp. 247. Moluccas.

Loc. Moluccas. Broome, Western Australia.

Remarks. Although this species and *spectrum* have been regarded as the same, they are here separated. Our specimens of this species are very bulbous and have the spire rounded off in the adult. Similar specimens of *spectrum* of the same size are definitely much narrower and with sharply defined colour pattern and centrally accuminate spire recalling in this respect *Pionoconous* such as the *janus* series.

TEXTILIA SPECTRA (Linné).

Conus spectrum Linné, 1758, p. 717. Asia.

Conus pica Adams and Reeve, 1848, p. 18, pl. 5, fig. 10a to 10d. Balambougan Island.

Loc. Moluccas. Queensland. East Cape, East Coast New Guinea.

GROUP K.

Genus FLORACONUS Iredale.

Floraconus Iredale, 1930, pt. 1, p. 80.

Genotype: *Conus anemone* Lamarck, 1810. New Holland.

Remarks. Shell variable in form, short and robust, spire short or elevated; spire and body whorl closely encircled throughout with close ridged striae; colour of a floral and variable pattern. Species here included such as *singletoni*, *remo*, *compressus*, *seagrovei*, *vincentianus* may be regarded by some as varieties or subspecies in the usual acceptance of these terms. However, in each case a long series in this collection critically examined has rather convinced me that there are considerable and consistent differences.

FLORACONUS ANEMONE (Lamarck).

Conus anemone Lamarck, 1810, p. 272. New Holland.

Conus roseotinctus Sowerby, 1866, p. 325. Hab.?

Conus novaehollandiae Adams, 1854, p. 119. Swan River.

Conus carmeli Tenison Woods, 1877, p. 134. North Coast, Tasmania.

Conus flindersi Brazier, 1898, p. 780. Flinders Island.

Loc. North, West, South Australia and Tasmania. Alive among rocks at low tide and dredged alive down to 10 fathoms and dead from 22 fathoms down.

Remarks. Very common and variable. I have not seen Brazier's type specimen of either *flindersi* or *remo*. Pritchard and Gatliff, 1900, p. 181, remark of these two species "We have carefully examined the types of the two last shells quoted,

described by Brazier, and are much surprised that such an authority should have forgotten his cunning to such an extent as to fail to recognize this common and variable species. The further encumbering of species by needless synonomy is difficult to restrain under present procedure, especially if those locally interested have no opportunity of criticism until after the mischief has been accomplished." In the following year, 1891, one of these gentlemen introduced the following species, *Conus segravei,* which may prove to be a subspecies of *anemone.* Lamarck describes the species as ashy-white or cinnamon coloured waved with brown and chestnut spots, with a white band. Variety *a* slightly yellowish, clouded with chestnut. Variety *b* bluish-white painted longitudinally with irregular oblong brown spots. The operculum is straight, long and narrow, about one-fourth of the length of the aperture and has its nucleus apical.

FLORACONUS SEGRAVEI (Gatliff).

Conus segravei Gatliff, 1891, p. 179, pl. 2, 3. Near Shoreham, Victoria.

Loc. South Australia down to 200 fathoms. Western Australia, down to 100 fathoms. Victoria.

Remarks. Specimens dredged alive down to 20 fathoms and dead at greater depths resemble this species. It may be the deeper water form of *anemone* to which it is closely allied.

FLORACONUS MACULOSUS (Sowerby).

Conus maculosus Sowerby, 1833, pt. 24, fig. 3, 3x. "Capul Island" error New South Wales.

Conus jukesi Reeve, 1848, pl. 2, sp. 278. North Australia.

Conus maculatus Sowerby, 1858, p. 31, pl. 13 (199), fig. 296. "Capul Island," New South Wales.

Conus rossiteri Brazier, 1870, p. 301. Botany Bay.

Loc. East Australia and Lord Howe Island. Sydney. Broken Bay. Balmoral.

Remarks. Very variable and common. The holotype of *rossiteri* D. 5795 is a juvenile

FLORACONUS CYANOSTOMUS (Adams).

Conus cyanostoma Adams, 1854, p. 116. W. Africa (?).

Conus coxeni Brazier, 1875, p. 34, pl. 4, fig. 10. Moreton Bay.

Conus innotabilis Smith, 1892, p. 487, pl. 40, fig. 1. New South Wales.

Loc. Queensland, Caloundra, Moreton Bay, New South Wales, Ballina.

Remarks. The type locality is East Australia not West Africa given by Adams in error. The Queensland and New South Wales shell do not show even subspecific differences.

FLORACONUS SINGLETONI sp. nov.

Shell rather small for the genus, white to cream without any other colouration; spire consistently moderately elevated sharp showing little or no variation in different specimens; spire and body whorl regularly spirally finely lirate, lirae on the body whorl coarser anteriorly, much coarser and posteriorly very fine medially; aperture pure white, narrow not much widening anteriorly, periostracum very thin, horn coloured. Height 45 mm., diameter 22 mm.

Loc. Victoria, Western Port (type loc.), Port Phillip Heads, Port Nepean. South Australia, MacDonnell Bay, West of Eucla, 100 fathoms, Yallingup; Western Australia.

Remarks. Holotype D. 14195, S.A. Mus. A series of twelve from the type locality and a couple from Port Phillip convinces me of the validity of this species and no doubt the animal when examined will show consistent differences from *anemone.* There may in certain specimens be a faint tinge of pink without pattern. The specimens from 100 fathoms are larger, measuring 54 mm. x 25 mm., but typical of the species and nothing to do with *anemone.*

FLORACONUS CLARUS (Smith).

Conus clarus Smith, 1881, p. 442. West Australia.

Loc.?

Remarks. This species is probably a *Floraconus* of the *anemone* type and may be a synonym of that species.

FLORACONUS ANGASI (Tryon).

Conus angasi Tryon, 1883, p. 62, pl. 19, fig. 99.

Conus metcalfei Angas, 1877, p. 173. Not *metcalfei* Reeve, 1843.

Conus Sydneyensis Sowerby, 1887, p. 260, pl. 32 (510), fig. 694. Port Jackson.

Loc. Port Stephens, New South Wales.

FLORACONUS PERONIANUS (Iredale).

Floraconus peronianus Iredale, 1931, p. 224, pl. 25, fig. 12. Sydney Harbour, dredged.

Loc. Broken Bay. Sydney Harbour. Tasmania.

Remarks. This large short spired and distinctly coloured shell has been regarded as a variety of *anemone.*

FLORACONUS APLUSTRE (Reeve).

Conus aplustre Reeve, 1843, pl. 30, sp. 170. Hab.?

Conus cooki Brazier, 1870, p. 300. Botany Bay.

Loc. Northern New South Wales, Richmond River, Ballina, Long Reef, Narrabeen, Broken Bay, Port Stephen. New Caledonia. Manus. Fiji. Western Australia, Shark Bay. Murray Island.

FLORACONUS PAPILLIFERUS (Sowerby).

Conus papilliferus Sowerby, 1834, pt. 56–57, fig. 79. Hab.?

Loc. Southern New South Wales.

FLORACONUS SAUNDERSI sp. nov.

Shell pyriform, rather wide, spire short, sharp with concave sides; body whorl and spire covered with regular spiral lirae; body whorl rather sharply angled at the shoulder, the top of the whorl and spire whorls forming a flat surface; outer lip convex, aperture rather wide, widening anteriorly; anterior quarter or base of the body whorl strongly spirally lirate; epidermis thin, light horn coloured; colour pattern of reddish brown axial flames, forming arrow-head-like points on the margins, directed away from the aperture, the whole on a cream ground colour; aperture light violet within.

Loc. Yorke Peninsula, Edithburgh, Levens Beach (type loc.). Port Lincoln, South Australia.

Remarks. This is one of the more distinctive species of the Southern Australian *Floraconus* types and is distinguished by the wide pyriform shell, which is thin, short spired, brightly coloured. As this paper was going to the press B. J. Weeding brought in a series from Daly Head which prove the species to be separable from *anemone* in all stages of development. Holotype D. 14198, S.A. Mus. Named after Saunders, a well-known South Australian shell collector.

FLORACONUS COMPRESSUS (Sowerby).

Conus compressus Sowerby, 1866, p. 325, pl. 25 (286), fig. 602, 603. Hab.?

Loc. Troubridge Island. Wallaroo. Encounter Bay, 22 fathoms, alive.

Remarks. Sowerby's name and figure probably apply to the tall spired, thick shelled compressed *Floraconus* type so well known to South Austraian collectors. Sowerby, in his original description, compared it with this series remarking, "This shell has some resemblance to *C. anemone*, but it is more solid in texture and the whorls are much more compressed, i.e., a greater number contained within a given circumference." The spire may be as long as the body whorl.

FLORACONUS REMO (Brazier).

Conus remo Brazier, p. 271. San Remo, Victoria.

Loc. San Remo. Port Philip. Port Macdonnell.

Remarks. From the long and consistent series of cotypes from the Kenyon Collection I have selected a specimen agreeing in all respects with the type. The species is like *singletoni* in general size and shape but is much thicker, elegantly splashed with bright orange, strongly spirally lirate throughout. All cotypes are similar in all respects. This may be a subspecies of *anemone* like others here separated but there is a definite difference from the typical *anemone*.

Genus PARVICONUS Cotton and Godfrey, 1932.

Parviconus Cotton and Godfrey, 1932, p. 68.

Genotype: *Conus rutilus* Menke, 1843. North-West Australia.

Remarks. Shell thin, small, somewhat inflated, slightly coronated, surface covered by close nearly obsolete revolving striae; rather sharp shoulder angle. Protoconch paucispiral, mamillate, smooth; there is an obliquely projecting sharp apex on its first whorl, which then acquires axial ribs from suture to suture, which become tubercles on the spire whorls through fading out of the upper part of the axial costae. The radulae teeth are short and probably of the type seen in *tessulatus* Born, *coronatus* Bruguière, etc.

PARVICONUS RUTILUS (Menke).

Conus rutilus Menke, 1843, sp. 27. In litore septentr.-occidentali.

Conus tasmanicus Tenison Woods, 1876, Proc. Roy. Soc. Tas., p. 139. Tasmania.

Conus macleayana Tenison Woods, 1877, Proc. Roy. Soc. Tas., p. 134. New name for *tasmanicaus* Tenison Woods, 1876, not Sowerby, 1866 (*tasmaniae*).

Loc. South Australia alive down to 15 fathoms, Levens, Largs Bay, Corny Point, Aldinga, St. Francis Island, Yatala Shoal, 10 fathoms, Beachport 40 fathoms, 110 fathoms, St. Francis Island 20 fathoms, Cape Borda 55 fathoms, Backstairs Passage 20 fathoms, Neptunes 45 fathoms. Western Australia, Ellen-

brook. King George Sound, Hopetown, Yallingup, eighty miles west of Eucla 80 fathoms. Victoria.

Remarks. Very variable in shape and colouring. The colour may be white, pink, yellow or brown. Some have three or four rows of large red spots, subdistant, as their only ornament on a ground colour of pink or purple. The spire may be flat or fairly elate. The sides of the body whorl may be straight, sloping, or somewhat convex below the shoulder angle, or with a vertical flat band below the angle of the spire, and then straight sloping and this form may have quite a turreted spire.

PARVICONUS SMITHI (Angas).

Stephanoconus Smithi Angas, 1877, p. 36, pl. 5, fig. 8. Cape Solander, Botany Bay.

Loc. Eastern Australia. Lord Howe Island.

Remarks. This species has a typical colouration of fillets of articulated spots.

Genus MAMICONUS Cotton and Godfrey, 1932.

Mamiconus Cotton and Godfrey, 1932, p. 69.

Genotype: *Conus superstes* Hedley, 1911. Cape Wiles, South Australia, 100 fathoms.

Remarks. Shell small, solid, regularly conical, angled at the shoulder; spiral cords numerous, defined by narrow, shallow grooves, becoming more crowded and oblique on the base; growth striae delicate; protoconch mamillate, smooth, two-whorled, slightly oblique; adult whorls four; mouth linear. The fossil *convexus* Harris from the Tertiary of Victoria probably belongs here.

MAMICONUS SUPERSTES (Hedley).

Conus superstes Hedley, 1911, p. 111, pl. 20, fig. 35, 36. Forty miles south of Cape Wiles, 10 fathoms.

Loc. South Australia, Cape Jaffa 90 fathoms. Western Australia, ninety miles west of Eucla, 104 fathoms; eighty miles west of Eucla, 80 fathoms and 120 fathoms.

GROUP L.

Genus HERMES Montfort.

Hermes Montfort, 1810, p. 399.

Genotype: *Conus nussatella* Linné, 1758. Island of Nussatella, Asia.

Theliconus Swainson, 1840, p. 312. Same genotype.

Remarks. Shell narrow, thick, spire short but accuminate; surface of body whorl finely, closely, lirate, lirae minutely granular.

HERMES NUSSATELLA (Linné).

Conus nussatella Linné, 1758, p. 716. Island of Nussatella.

Loc. East Cape, Papua. Queensland. Philippines. Fiji.

Remarks. One juvenile from Papua, large specimens from Queensland.

HERMES LUTEUS (Sowerby).

Conus luteus Sowerby, 1833, pt. 25, fig. 8 and 8x. Hab.?

Conus nucleus Reeve, 1848, pl. 3, sp. 280. Matnog.

Loc. Annaa Island. Kenyon Collection. Western Australia, Shark Bay. Northern Territory.

Remarks. Also recorded from King George Sound, Western Australia.

HERMES TENDINEUS (Bruguière).

Conus tendineus Bruguière, 1792. p. 733. Africa.

Conus granulosus Sowerby, 1834, p. 18. Annaa Island.

Loc. Mauritius. Kenyon Collection.

HERMES TEREBELLUM (Linné).

Conus terebellum Linné, 1758, p. 718. Asia.

Cons terebra Born, 1780, p. 162. Hab.?

Conus coelebs Hind, 1843, p. 256. Fiji.

Loc. Fiji, Loma Loma. Philippines. New Guinea. Mauritius.

Remarks. Recorded from Swan River, Western Australia and Queensland.

HERMES THOMASI (Sowerby).

Conus thomasi Sowerby, 1881, p. 635, pl. 56, fig. 4. Red Sea.

Loc. Red Sea.

Remarks. Our single specimen from Aden is much less coarsely spirally sculptured than *terebellum* and in addition the spire is shorter.

HERMES CIRCUMCISUS (Born).

Conus circumcisus Born, 1780, p. 163. Hab.?

Conus brazieri Sowerby, 1881, *a* p. 734, pl. 1, fig. 9. Solomon Islands.

Conus dux Bruguière, 1792, p. 732. Grandes Indes.

Loc. Moluccas. Amboina. Kenyon Collection. Solomon Islands.

HERMES CLAVUS (Linné)

Conus clavus Linné, 1758, p. 716. Hab.?

Loc. "New Caledonia", Kenyon Collection. Fiji.

Remarks. One perfect example of this specimen measuring 52 mm. in height is in the Kenyon Collection with the above locality. It has all the characteristics of the genus, except that the colour pattern is somewhat like that of *Darioconus*.

HERMES AURISIACUS (Linné).

Conus aurisiacus Linné, 1758, p. 716. Hab.?

Loc. Moluccas. Kenyon Collection.

HERMES TRIGGI sp. nov.

Shell long and rather narrow, thick, spire smooth, elevated, conic, acute, whorls shallowly channelled and crossed by fine accremental striae; body whorl

with almost straight sides, slightly convex below, angled at the shoulder, lirate anteriorly; lirae gradually becoming obsolete anteriorly; colouration white, axially clouded with brown, cut by a narrow white spiral at the basal third; whole surface of the body whorl with spirals of regular minute brown dots, the shoulder angle of the spire whorls with a single spiral of slightly larger spots; outer lip thick; aperture narrow and white. Height 60 mm., diameter 27 mm.

Loc. "New Hebrides."

Remarks. This unique specimen has somewhat the colour pattern of the *interruptus* series something like *tornatus* Röding, 1798, *nom. nud.*, "Broderip." Sowerby, 1833, pt. 29, fig. 25, but is more solid, less acute, almost straight sided, less gradate spire. It also recalls to some extent the obscure *lemniscatus* Reeve, 1849, pl. 5, sp. 246, from unknown locality which has a straight sided body whorl. However, the present shell is undoubtedly related to *aurisiacus* belonging to the genus *Hermes*. The new species is readily distinguished from *aurisiacus* by the differently sculptured and shaped spire and distinctive colour pattern. *Conus suzoni* Bartsch 1939, p. 1, fig. 1–3, from Florida bears some resemblance, but differs in shape, the sides being straight and, if anything, concave, in that species, while the colour pattern is coarser with a tendency to form axial lines, entirely absent in the fine pattern of *triggi*. The Kenyon label with this and two or three assorted broken cones read "New Hebrides." Named after Frank Trigg, a keen South Australian collector of Cone Shells.

Genus Leporiconus Iredale.

Leporiconus Iredale, 1930, p. 79.

Genotype: *Conus glans* Bruguière, 1792. Africa.

Remarks. Shell narrow but wider than in *Hermes* and slightly pyriform; spire short and obtuse; body whorl sculptured with rather coarse, granular spirals.

Leporiconus glans (Bruguière).

Conus glans Bruguière, 1792, p. 735. Hab.?

Loc. Philippines. Kenyon Collection. Queensland. New Caledonia. Manus. Fiji.

Remarks. Also recorded from Exmouth Gulf, North-Western Australia.

Leporiconus tenuistriatus (Sowerby).

Conus tenuistriatus Sowerby, 1858, p. 46, pl. 22, fig. 314. Philippines.

Loc. Kenyon Collection. Queensland. East Coast Papua.

Remarks. A series in the Kenyon Collection agrees with the original description and has the locality quoted "Philippines and New Caledonia." They are larger and less coarsely sculptured than any of the *glans* series and seem distinct, though *tenuistriatus* has usually been regarded as a synonym of that species.

Leporiconus coccineus (Gmelin).

Conus coccineus Gmelin, 1791, p. 3390. Hab.? Not Sowerby, 1866.

Conus solandri Broderip and Sowerby, 1830, p. 50, tab. suppl. 40, fig. 4. Tahiti.

Loc. Lifou. Kenyon Collection. Queensland. Fiji.

LEPORICONUS GRANULATUS (Linné).

Conus granulatus Linné, 1758, p. 716. O. Africano. Not Röding, 1798, or Borson, 1830, or Sowerby, 1834.

Conus roseus Lamarck, 1810, p. 37. Antilles.

Conus verulosus Bruguière, 1792, p. 719. Seas of America.

Loc. West Indies.

LEPORICONUS SCABRIUSCULUS (Dillwyn).

Conus scabriusculus Dillwyn, 1817, p. 406. Guinea Coast.

Conus fabula Sowerby, 1833, pt. 24, fig. 5, 5x. Hab.?

Loc. New Caledonia.

LEPORICONUS MITRATUS (Bruguière).

Conus mitratus Bruguière, 1792, p. 738. Indian Ocean.

Loc. New Caledonia. Philippines.

LEPORICONUS CYLINDRACEUS (Broderip and Sowerby).

Conus cylindraceus Broderip and Sowerby, 1830, p. 51. Hab.?

Loc. Society Islands. New Caledonia. Loyalty Islands, Lifou. Fiji.

LEPORICONUS NIMBOSUS (Solander).

Conus nimbosus Solander, 1786, p. 134. Hab.?

Loc. Ceylon.

LEPORICONUS BOUGEI (Sowerby).

Conus bougei Sowerby, 1907, p. 299, pl. 25, fig. 1, 2. Mouac Island, New Caledonia.

Loc. Mouac Island, New Caledonia. Lifou, Loyalty Islands.

GROUP M.

Genus ASPRELLA Schaufuss.

Asprella Schaufuss, 1869, p. 7.

Genotype: *Conus sulcatus.*

Cylindrella Swainson, 1840, p. 311.

Genotype: *Conus asper* Lamarck, 1810. China.

Conus sulcatus Bruguière, 1792. East Indies.

Remarks. Shell with revolving grooves over all the body whorl, crossed by longitudinal striae, the intermediate spiral ridges flat or rounded; spire sharp, carinated, sometimes with distant compressed tubercles; shoulder angle sharp.

ASPRELLA SULCATA (Bruguière).

Conus sulcatus Bruguière, 1792, p. 618. East Indies.

Conus asper Lamarck, 1810, p. 39. China.

Conus bocki Sowerby, 1881, p. 636, pl. 56, fig. 7. Amboina.

Loc. Ceylon. Hong Kong. Kenyon Collection.

Remarks. Our specimen of *bocki* from Amboina is merely a more coarsely granulate variety of *sulcatus*, intergrading with specimens of that species.

ASPRELLA GRACILIS (Sowerby).

Conus australis Lamarck, 1810, p. 439. "Botany Bay," etc. Not *australis* Schroeter, 1803.

Conus gracilis Sowerby, 1823, pt. 16, pl. 267, fig. 4. Hab.?

Conus laterculatus Sowerby, 1870, p. 255, pl. 22, fig. 3. Hab.?

Loc. Hong Kong. Kenyon Collection. China. Moluccas. Western Australia, Shark Bay.

Remarks. Recorded from "Swan River, Western Australia."

ASPRELLA ORBIGNYI (Audouin).

Conus orbignyi Audouin, 1831, pl. 20. China.

Conus d'orbignyi Weinkauff, 1874, p. 258.
For *orbignyi* Audouin.

Loc. Hong Kong.

ASPRELLA MILESI (Smith).

Conus milesi Smith, 1887, p. 244. Muscat.

Loc. Arabian Sea.

ASPRELLA ACULEIFORMIS (Reeve).

Conus aculeiformis Reeve, 1844, pl. 44, sp. 240. Cagayan.

Conus vimineus Reeve, 1849, pl. 7, sp. 269. Cagayan.

Conus insculptus Kiener, 1850, p. 309, pl. 99, fig. 2. China Seas.

Loc. Kenyon Collection.

Remarks. Our specimen is a variety of *gracilis* Sowerby and *aculeiformis* may be a synonym. Also recorded from North-Western Australia.

ASPRELLA COROMANDELICUS (Smith).

Conus coromandelicus Smith, 1894, p. 159, pl. 4, fig. 1, 2. Off Coromandel Coast.

Loc. Off Jash, 170 fathoms.

ASPRELLA TANNAENSIS sp. nov.

Shell narrow, spire much elevated, being over one-third of the entire shell height, spirally lirate, but smooth at the upper portions of the whorls below the suture; spirally regularly grooved all over the body whorl and lightly marked by axial accremental striae; spiral cords between the grooves smooth and polished, no granules anywhere on the shell; body whorl almost straight-sided but acutely tapering anteriorly, tip sharp; colouration distinctive of golden yellow finely streaked with fine rosy axially vermiculate lines at the shoulder and a short way below; vermiculations repeated briefly and in spirals three or four times on the body whorl; spaced irregular subtrigonal spots at odd places. Height 80 mm., diameter 27 mm.

Loc. Tanna, New Hebrides (type loc.).

Remarks. Holotype D. 6172. S.A. Mus. Unique This very distinctive specimen is in the Kenyon Collection, bearing Brazier's label with the above locality, but without name.

ASPRELLA ORBITATUS (Reeve).

Conus mucronatus Reeve, 1843, pl. 37, sp. 204. Philippine Islands.

Conus alabaster Reeve, 1843, pl. 6, sp. 257. China Sea.

Conus orbitatus Reeve, 1843, pl. 27, sp. 156. Hab.?

Loc. Philippines. Manus.

Remarks. The Manus specimen is small and worn. Recorded from Queensland.

ASPRELLA UNDATUS (Kiener).

Conus undatus Kiener, 1848, p. 210, pl. 94, fig. 1. Indian Ocean.

Conus sowerbyi subaequalis Sowerby, 1870, p. 257, pl. 22, fig. 5. China Seas.

Loc. "Florida."

Remarks. Our specimens from the above locality are typical.

ASPRELLA VERRUCOSA (Bruguière).

Conus verrucosus Bruguière, 1792, p. 708. Africa, etc.

Conus echinulatus Kiener, 1849, p. 270, pl. 105, fig. 2. Hab.?

Conus nodiferus Kiener, 1849, p. 228, pl. 100, fig. 4. Mer des Indes.

Conus rapillosus Kiener, 1849, p. 271, pl. 72, fig. 4. Hab.?

Conus stictus Adams, 1854, p. 117. Hab.? (Not *strictus*, spelling error).

Conus mindanus Bruguière, 1792, p. 711. Philippines.

Conus cretaceus Kiener, 1849, p. 264, pl. 99, fig. 1. Hab.?

Conus anaglypticus Crosse, 1865, p. 314, pl. 11, fig. 8, 8a. Antilles.

Conus elventinus Duclos, 1833, pl. 19. Hab.?

Loc. West Indies. Bahamas. Antilles.

ASPRELLA WILMERI (Sowerby).

Conus wilmeri Sowerby, 1882, p. 118, pl. 5, fig. 5. Port Blair.

Loc. Kenyon Collection.

Genus CONASPRELLA Thiele.

Conasprella Thiele, 1929, p. 373.

Genotype: *Conus cancellatus* Bruguière, 1792. Hawaii.

Remarks. Shell pyriform, sharply angled at the shoulder, contracted towards the base; body whorl closely sulcate throughout, sulci axially finely striate. Radula teeth moderately long with three small barbs somewhat cylindrical shafts and no denticulated edge as found in *Floraconus* and *Puncticulis*.

CONASPRELLA CANCELLATA (Bruguière).

Conus cancellatus Bruguière, 1792, p. 712.

Conus praecellens Adams, 1854, p. 119. China Seas.

Conus turriculatus Sowerby, 1866, pl. 27 (288), fig. 643, 644. Hab.?

Loc. Hong Kong.

Remarks. Recorded from Assini Island, Western Australia and Queensland.

CONASPRELLA SECULARIS (Melvill).

Conus secularis Melvill.

Loc. Persian Gulf.

Remarks. A specimen sent to Verco by Sowerby bearing the above name and locality in Sowerby's handwriting is in the collection. I cannot find any references in literature. It is like a small *cancellatus*.

CONASPRELLA ACUTANGULUS (Lamarck).

Conus acutangulus Lamarck, 1810, p. 286. Mers des grandes Indes.

Loc. Philippines.

Remarks. Closely related to *cancellatus* conchologically. The radula tooth is without the denticulated edge of *Floraconus* and the operculum has the inner edge scalloped. *Conasprella* is somewhat similar to *Conorbis* Swainson, 1840 (*Conus dormiter*), an Eocene and Oligocene genus.

CONASPRELLA FILAMENTOSA (Reeve).

Conus filamentosus Reeve, 1849, pl. 6, sp. 260. Hab.?

Loc. Lifou.

Remarks. A series of typical specimens from the above locality ranging from 32 mm. down to 15 mm. in height. Not typical of the genus.

Genus ENDEMOCONUS Iredale.

Endemoconus Iredale, 1931, 225.

Genotype: *Conus howelli*, 1929. Montague Island, New South Wales, trawled.

Remarks. Medium size, strictly conical, sharply angulate at the shoulder, early whorls concave above, spire acute, less than half the length of the aperture; subcarinate at shoulder angle, subdued anterior spiral lirae. Recalls the Eocene fossil *Conus ligatus* Tate.

ENDEMOCONUS HOWELLI Iredale, 1929.

Conus howelli Iredale, 1929, p. 182, pl. 40, fig. 1, 8, Montague Island, New South Wales, trawled, 50 to 60 fathoms.

Loc. Type locality only.

Remarks. This remarkable and distinct species is not represented in the collection.

GROUP N.

Genus LOVELLONA Iredale.

Lovellona Iredale, 1917, 12, p. 329.

Conus atramentosus Reeve, 1849. Mindoro, Philippine Islands.

Remarks. The type species has been placed with the Columbelloid shells and by Thiele, 1929, under family Conidae, subfamily Cytharinae as distinct from his subfamily Coninae which covers family Conidae of the present paper.

LOVELLONA ATRAMENTOSUS (Reeve).

Conus atramentosus Reeve, 1849, pl. 7, sp. 265. Mindora, Philippine Islands.

Loc. Queensland.

LOVELLONA PEASEANA (Finlay).

Conus fusiformis Pease, 1861, p. 398. Sander Island.
Not *fusiformis* Fischer, 1807.

Conus parvus Pease, 1868, p. 126. New name for *fusiformis* Pease.
Not *parvus* Lamarck, 1810.

Conus peaseana Finlay, 1927, p. 519. New name for *parvus* Pease.

Loc. Queensland.

LOVELLONA MICARIUS (Hedley).

Conus micarius Hedley, 1912, p. 147, pl. 43, fig. 32. Queensland, 15 miles S.W. of Cape York.

Loc. Queensland.

LOVELLONA GRAYI (Reeve).

Conus grayi Reeve, 1844, pl. 46, sp. 258, a, b, c. Hab.?

Conus obtusus Kiener, 1850, p. 317, pl. 109, fig. 3. Hab.?

Loc. "Australia."

Remarks. Two adult and perfect specimens are in the collection. One is labelled "Australia?" and the other is from the May Collection in a tray with Western Australian shells, though there is not guarantee that it is from that locality.

SUMMARY.

1. The family Conidae can be divided into groups probably representing subfamilies.
2. The groups are composed of natural genera containing related species, but more generic names will be required before a satisfactory classification can be offered.
3. Some of the "variable" and widely distributed "species" may each represent a complex of geographic, deep or shallow water subspecies, requiring more material and definitely localized specimens to elucidate.
4. The structure, shape, and detail function of the radula denticles in various species, varies considerably.
5. The denticles are readily torn at the base, from the delicate radula ribbon, probably by muscular action against the anchoring of the barbs.
6. The radula of the common South Australian Cone Shell *Floraconus anemone* is poisonous.

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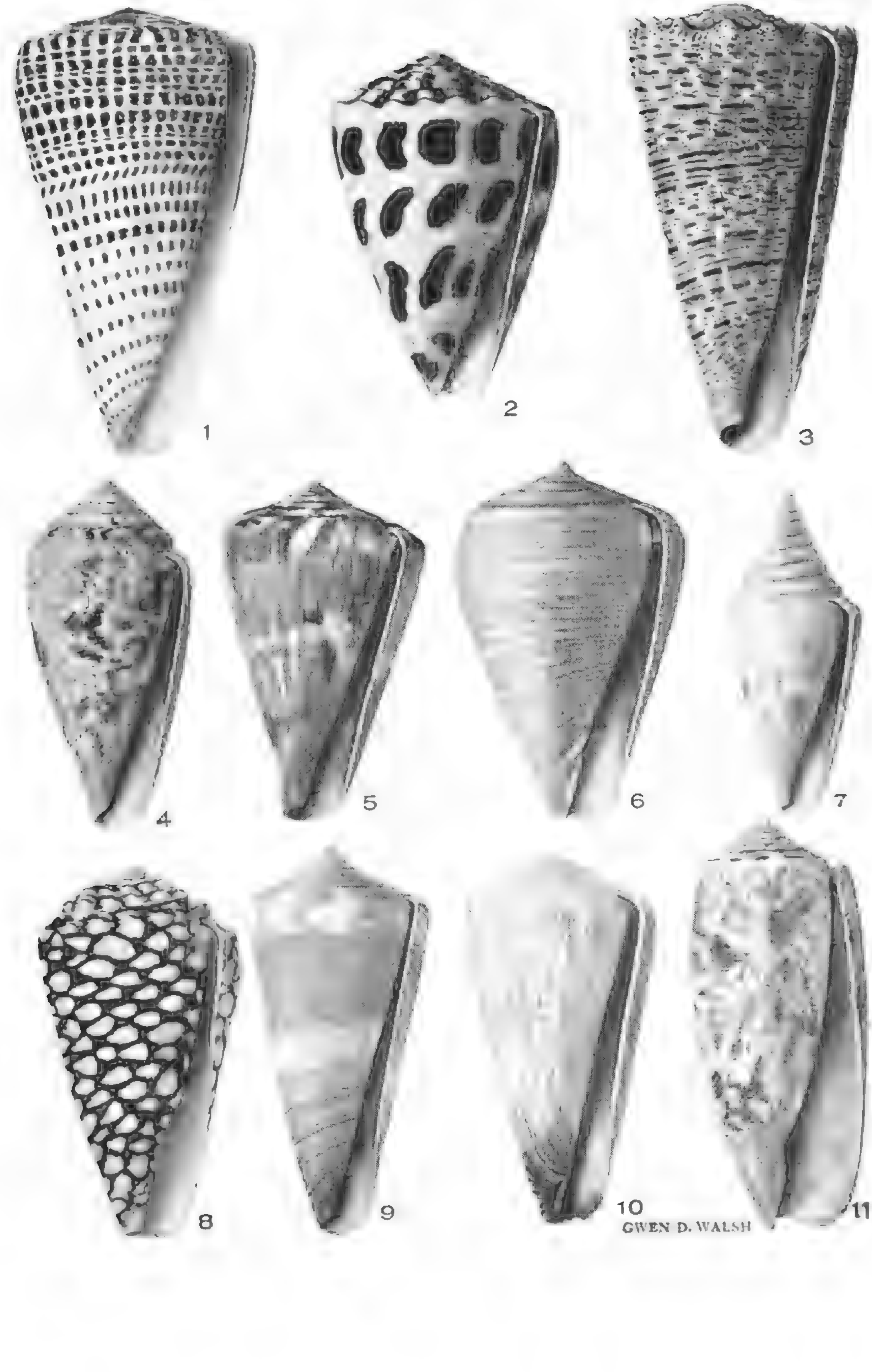
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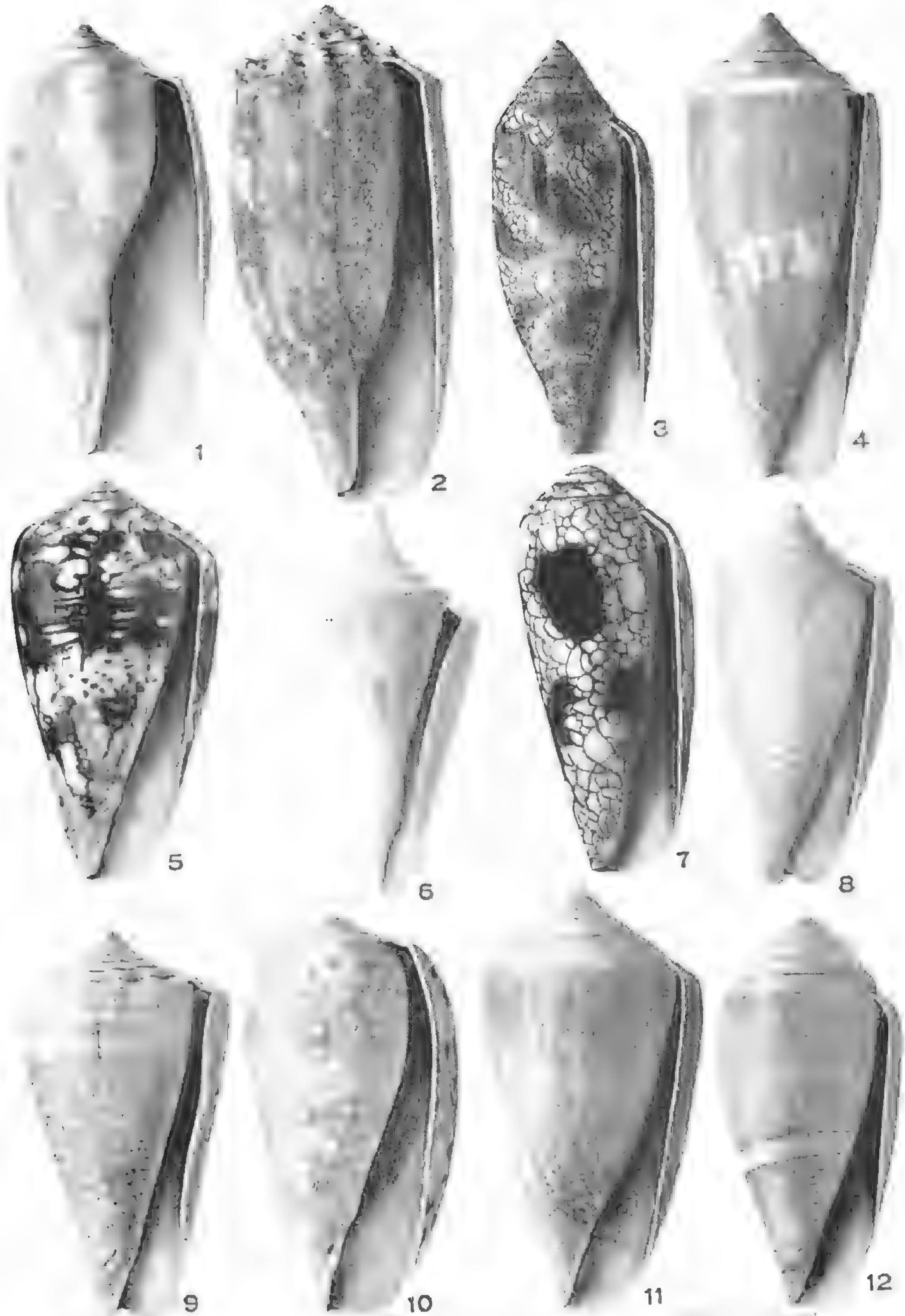

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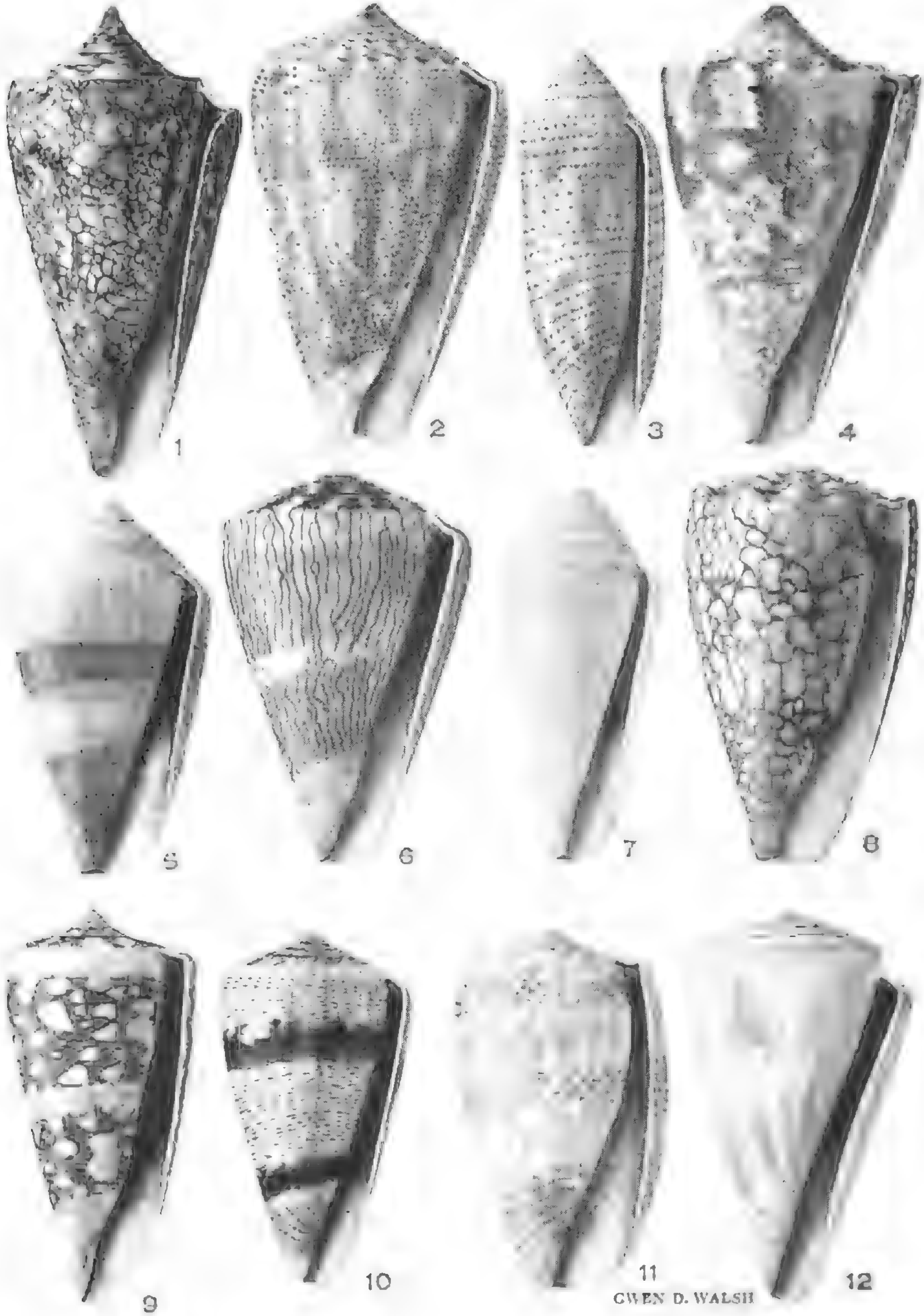
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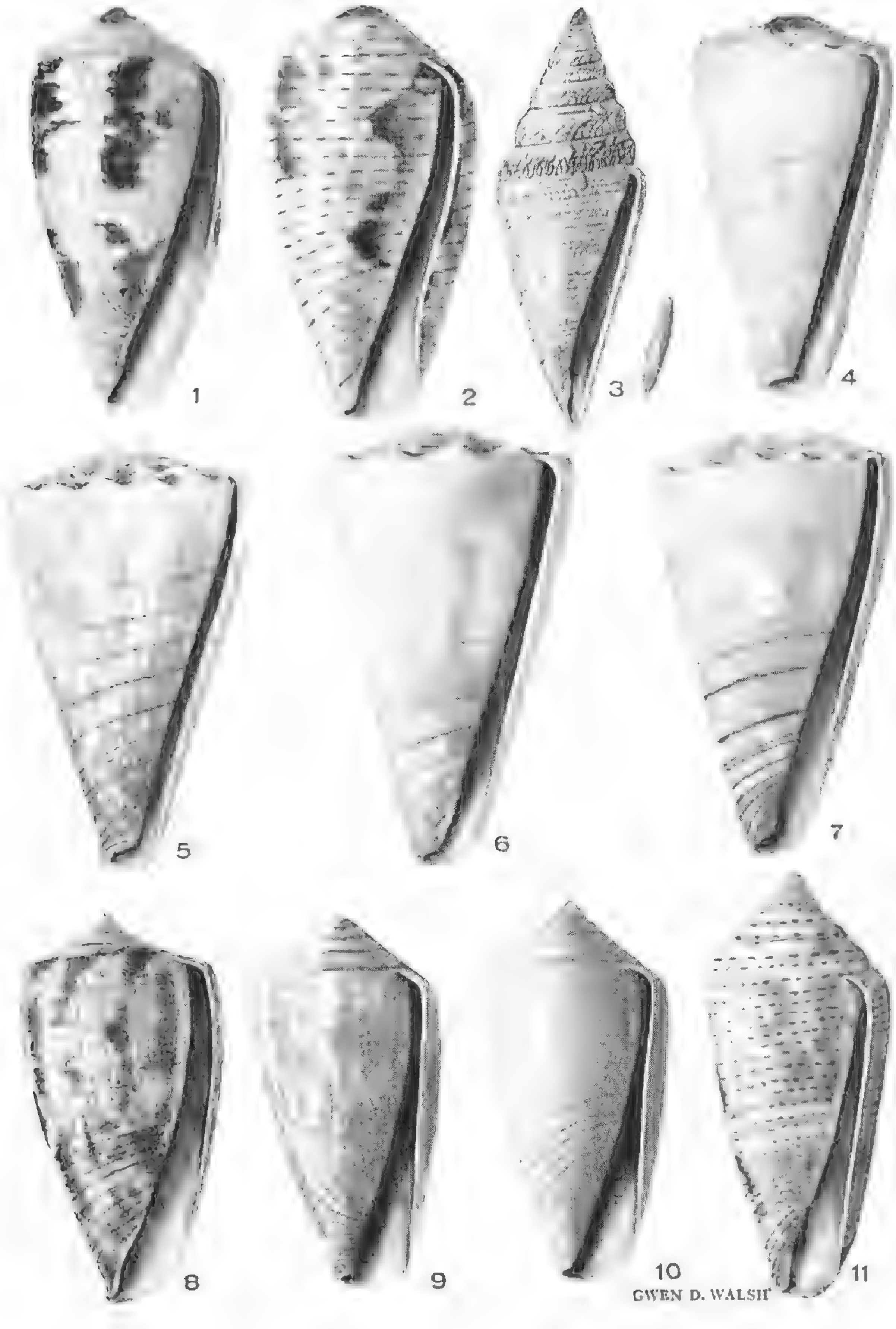
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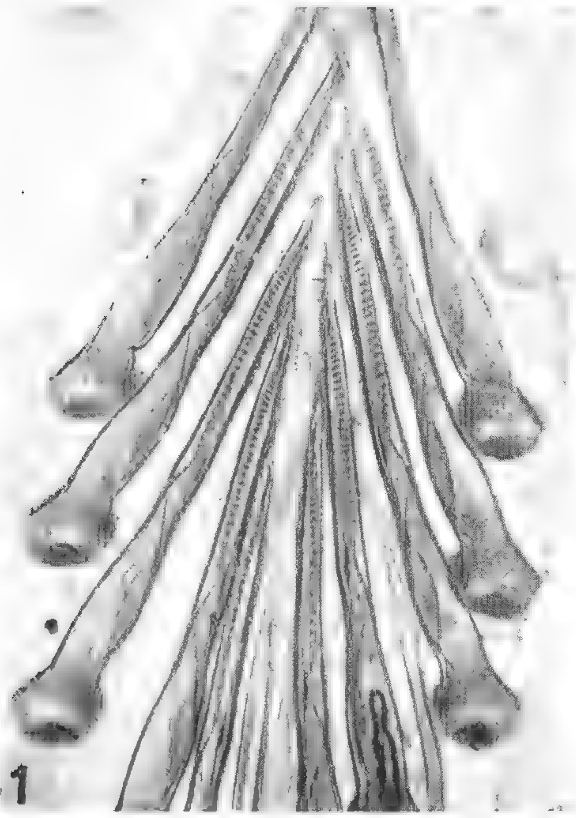
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BIFACED STONE IMPLEMENTS FROM SOUTH-EASTERN SOUTH AUSTRALIA

BY P. DE S. STAPLETON

Summary

This paper records the occurrence, and furnishes description, of biface flaked flint implements collected near the shore in the vicinity of Cape Northumberland, Hundred of MacDonnell, County Grey, South Australia, in 1906.
In more recent years, Mr. C. Kurtze and his son, of Portland, Victoria, collected large numbers of these unusual stone artefacts near Cape Northumberland and from various camp sites along the coast to the south-east and north-west. Apparently much of this collection has been sold to tourists and museums, both in Australia and abroad. And although many specimens were collected and disposed of, it seems no record was made of their occurrence and distribution, or of the circumstances of their collection.

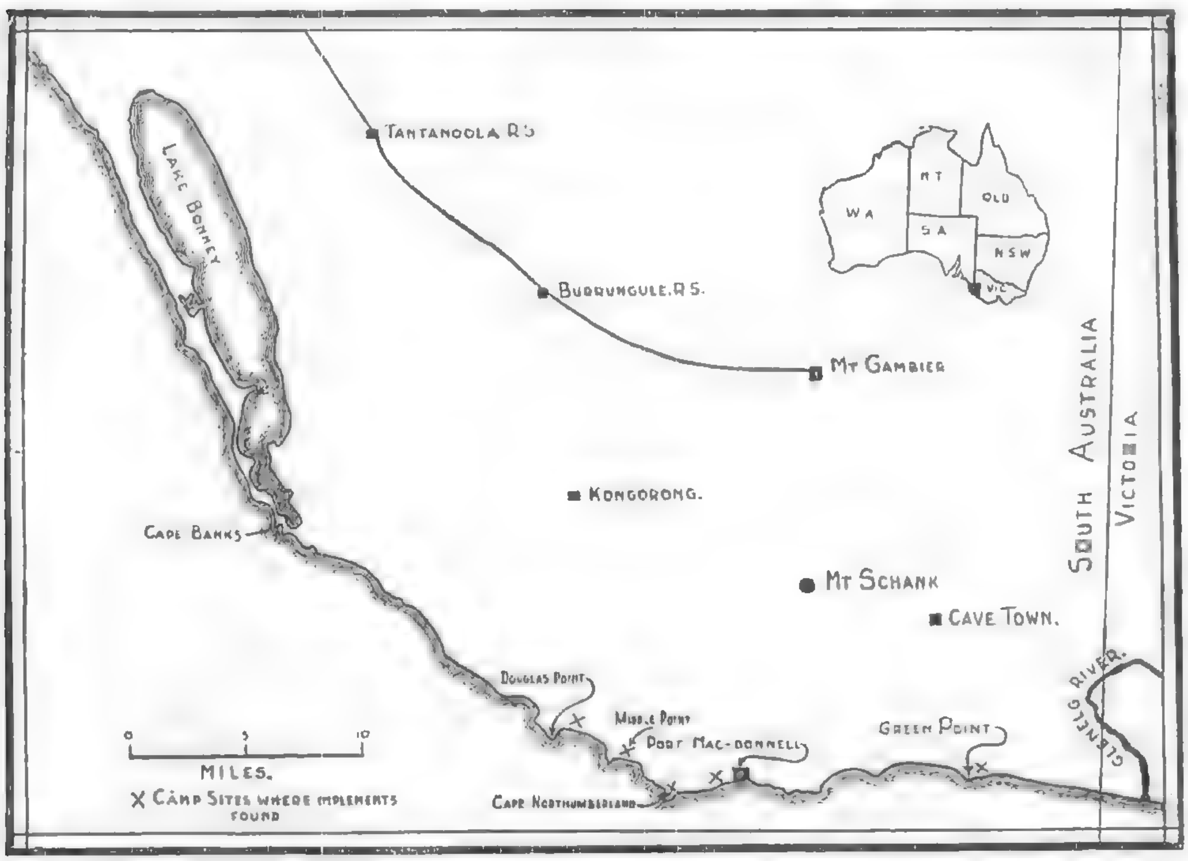
BIFACED STONE IMPLEMENTS FROM SOUTH-EASTERN SOUTH AUSTRALIA

By P. de S. STAPLETON.

Map and Fig. 1–11.

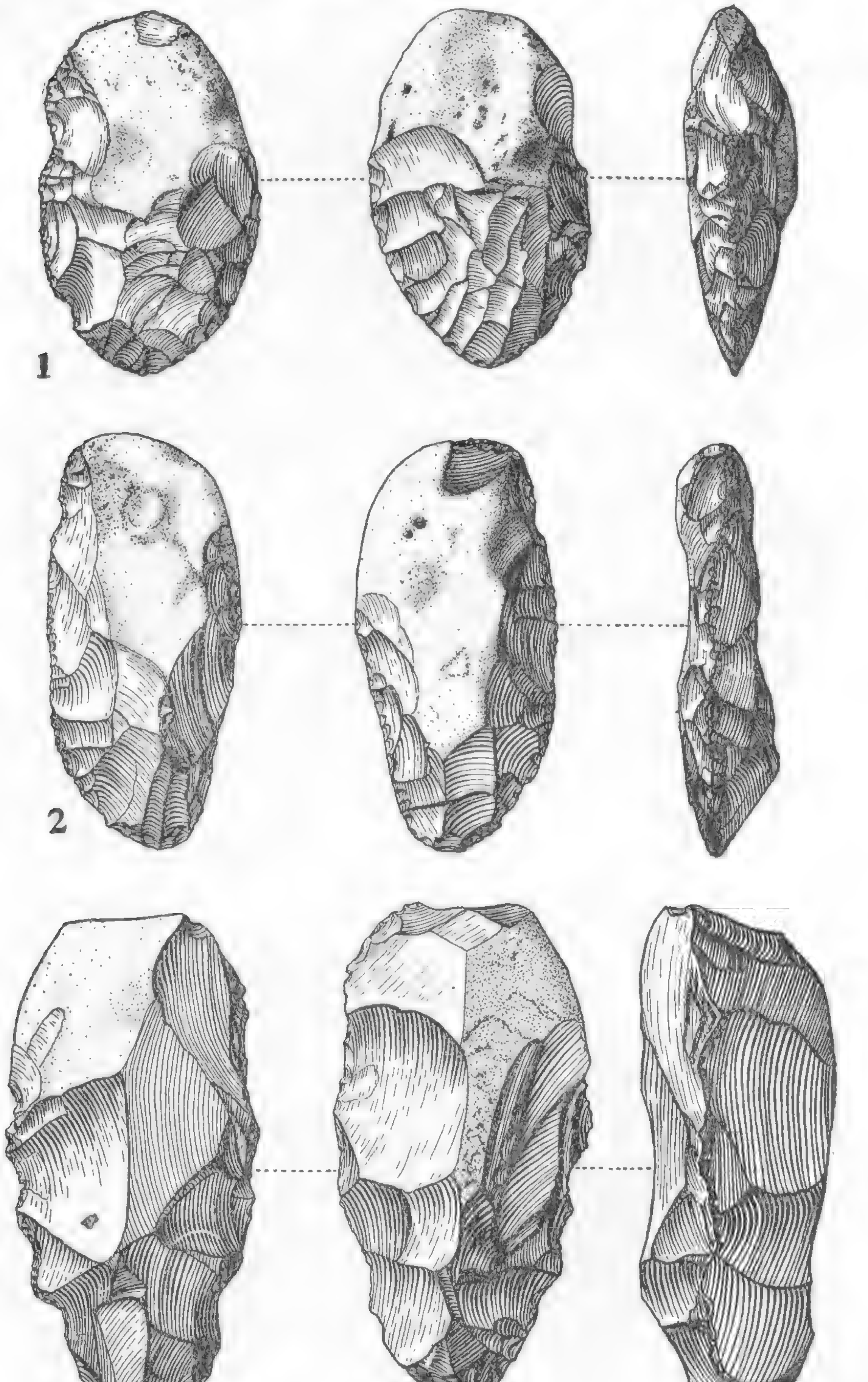
This paper records the occurrence, and furnishes description, of biface flaked flint implements collected near the shore in the vicinity of Cape Northumberland, Hundred of MacDonnell, County Grey, South Australia, in 1906.

In more recent years, Mr. C. Kurtze and his son, of Portland, Victoria, collected large numbers of these unusual stone artefacts near Cape Northumberland



and from various camp sites along the coast to the south-east and north-west. Apparently much of this collection has been sold to tourists and museums, both in Australia and abroad. And although many specimens were collected and disposed of, it seems no record was made of their occurrence and distribution, or of the circumstances of their collection.

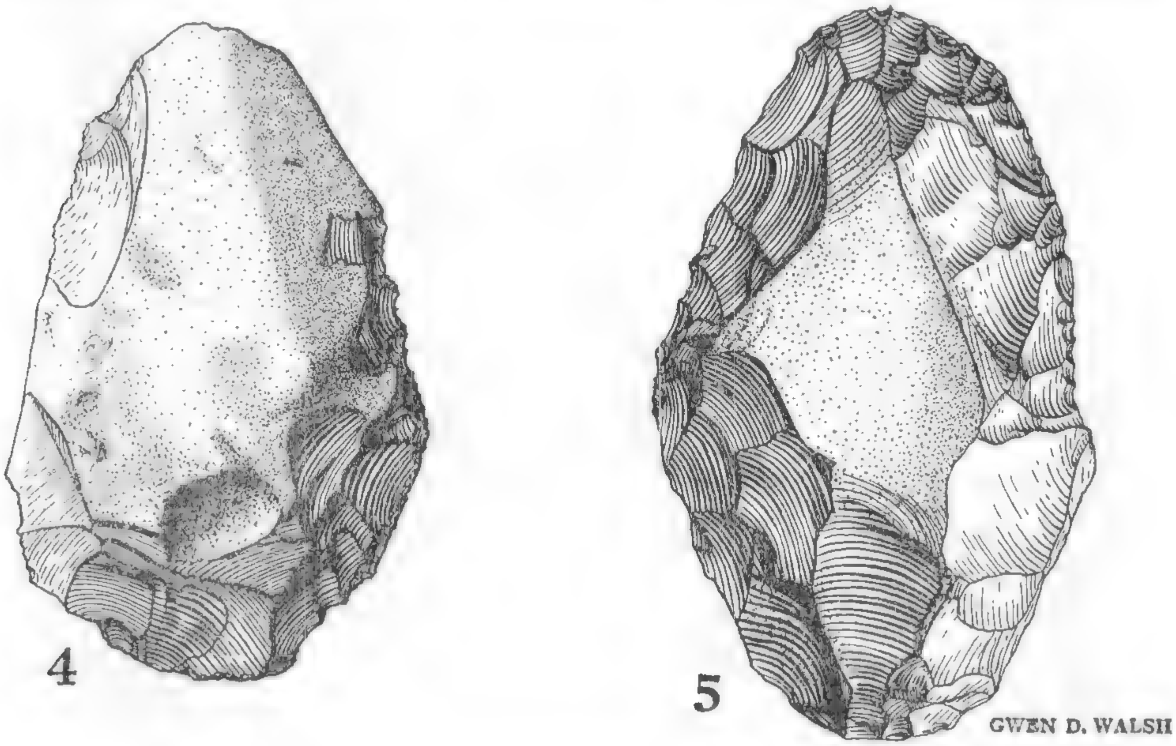
As these artefacts have not been recorded by workers on Australian aboriginal material culture, the writer arranged a series for study. Some of these were presented to a Victorian collector who was planning to produce a monograph on Australian stone implements, while the remainder, sixteen in number, later were presented, togther with the author's general collection to the South Australian Museum. As the monograph was not published the following short paper gives details of a representative series of these specimens of aboriginal handiwork, which might appropriately be called the "Buandik biface" (Campbell, 1934).



Bifaced Implements, Class A (3/7 nat. size).

The camp-sites on which the implements were found occur in a region previously occupied by the Buandik tribe of aboriginals, whose territory, according to Mrs. James Smith (Smith, 1880), consisted of the tract of country extending from the mouth of the Glenelg River to Rivoli Bay North, and for about thirty miles inland.

This must indeed have been a land of plenty for its inhabitants. The coastal rock formations were most favourable for the catching of fish of many kinds, and rock lobsters *(Jasus lalandii)* were abundant. There were also fresh water streams containing eels, *(Aguilla* sp.) and one in which mullet *(Agonostomus forsteri)*

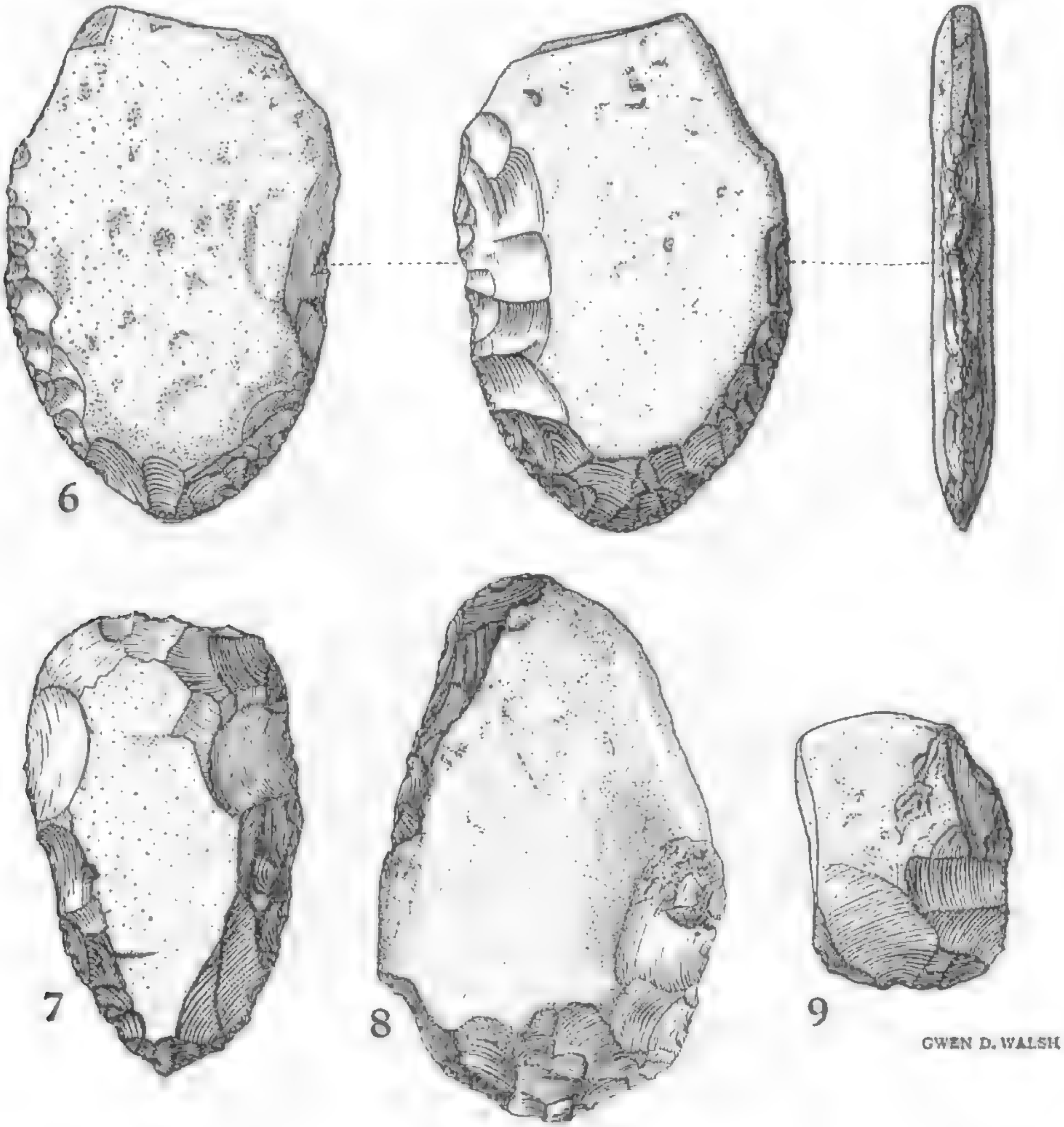


Bifaced Implements, Class A (½ nat. size).

could easily be caught. The Glenelg River is noted at the present day for its mulloway (*Sciaena antarctica*), its black bream (*Sparus australis*), and its Taralgi (*Percalates colonorum*). Wild fowl were plentiful in the adjourning swamplands and marsupials large and small abundant in the bracken, ti-tree, forests, and the grasslands.

DESCRIPTION OF SITES.

The site of the camp where the implements were first found was on the shore approximately 2 miles west-north-west of Cape Northumberland lighthouse in the Hundred of MacDonnell (see Map). At this place the shore is banked by flint pebbles of varying sizes, eroded from the soft marine rocks outcropping on that part of the coast. The top of these banks was overlain with sand forming a coastal shelf and showed indications of native occupation. Piles of fire-blackened stones with charcoal and ashes indicated the remains of hearths, while large numbers of flint flakes were strewn over the site. Here the author also found bone artefacts resembling the pointing bone of the lower Murray River (in the author's



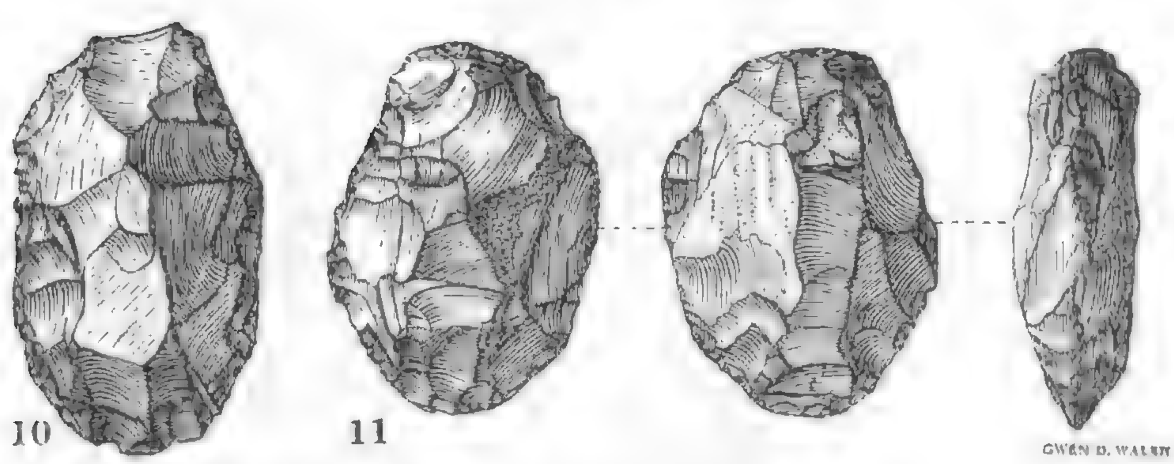


Fig. 6–9. Bifaced Implements, Class B. (3/7 nat. size).
Fig. 10–11. Bifaced Implements, Class C. (1/3 nat. size).

collection at present in the South Australian Museum). Bone implements resembling these are said to have been used for removing molluscs from their shells (Kenyon, 1912). Owing to the nature of the coast this is a probable explanation. The place appeared to be the site of a factory for producing flaked flint implements of the larger kinds. Great numbers of these lay about, but most were of crude manufacture.

DESCRIPTION OF TEXT FIGURES.

For the purposes of description the specimens figured are divided into three classes.

Class A. Those made from nodules, requiring partial flaking to reduce them to the required form.

Class B. Those made from tabules or tablets which have only been flaked sufficiently to form the required cutting edges.

Class C. Those flaked all over, or nearly so.

CLASS A.

Fig. 1. Green Point (see map). A skilfully flaked and symmetrical axe-like implement.

Fig. 2. Douglas Point (see map). A cutting edge is carried completely up one side.

Fig. 3. Douglas Point. This represents a different form from any others figured. It is 17·5 cm. along the major axis and 6 cm. in greatest thickness, tapers to the point, and has a rhomboidal section; weight 31 ozs.

Fig. 4. Green Point. An example ovoid in outline; it has not flaked well, the fracture tending to run inwards, producing concavities which have left a rough irregular edge. It resembes the Coup de Poing type.

Fig. 5. Green Point. Elliptical and double ended.

CLASS B.

Fig. 6. Green Point. The flaking is carried high up both sides and is fine, resulting in a keen even edge. An example of a very fine tool, produced with a minimum of work.

Fig. 7. Green Point. The flaked edges extend nearly to the top on both sides: finely executed.

Fig. 8. Cape Northumberland (see map). A "Chellean" type of Coup de Poing.

Fig. 9. Cape Northumberland. Flaked to an edge entirely along one side and one end, and in this respect resembling the example illustrated in fig. 2.

CLASS C.

Fig. 10. Cape Northumberland. The cutting edge extends almost to the top on both sides.

Fig. 11. Cape Northumberland. An example of skilful shaping by flaking.

ANTIQUITY.

As to the antiquity of these implements there is little to serve as a guide. All the specimens are bleached on one side, probably the side which has been uppermost and exposed since last used. Nothing seems to be known definitely of the rate or the conditions under which this "patination", or bleaching takes place; so the feature cannot be expected to furnish any clue as to age.

RELATIONSHIP TO OTHER TYPES IN GENERAL.

It will be noted that the most carefully worked specimens are almond shaped, resembling the "Acheulean" type of South-Western Europe. This feature is uncommon among ground axes and probably results from blanks having that shape.

Kenyon (1912) says "Along the Portland beaches flint nodules occur in great number while there is no other useful local rock except basalt. Chipped flint implements are lying in every direction. Every Tasmanian implement found may be duplicated there, while all the palaeolithic implements of Europe and America can be duplicated." He continues, quoting from Seton-Karr, "It is indeed probable that peculiar types discovered in different parts of the world have been evolved through the local material." Professor Spencer, in referring to the occurrence side by side of both neolithic and palaeolithic types, says "The matter is largely concerned with the kind of stone which is procurable."

Mitchell (1943) writes "Only two of the larger implements of flint flaked on two sides were found, and one badly-weathered ground edged axe of basalt. The former type is very common on some of the coastal dunes in Victoria, together with a 'coup de poing' type and it is possible that many of those described as choppers should be classed as blanks or cores, the purpose of the flaking being to ascertain whether the internal flint was suitable, and reserved for future use." The present writer arrived at a similar conclusion on account of the large number of poorly executed examples lying about the factory site and the better specimens being found in camp-sites elsewhere. The impression gained was that the poorer types were mainly rejects. The specimens listed as from Cape Northumberland were found on typical cliff-top camp-sites. From this place, three miles W.N.W. to Douglas Point, Hundred of Kongorong, and twelve miles east from Cape Northumberland to Green Point, Hundred of Caroline, mark the limits within which the author collected these artefacts. All were found on camp-sites in the immediate vicinity of the sea. Ground axeheads, probably from the factories of Mount William and other sites in Victoria, have been found plentifully throughout this district; also some grooved wedges in the author's collection in the South Australian Museum. In one camp-site, a considerable area of blown sand, adjacent to Green Point, the writer found twelve ground axes.

Mr. P. S. Hossfeld, M.Sc., has kindly furnished the following geological notes on the occurrence of the flint in the region under discussion.

"Flint which in the South-East of South Australia is the predominant material used by the natives for their stone implements, is derived primarily from certain horizons in the limestones of Tertiary Age which outcrop at a number of places both inland and on the coast.

"Accumulations of flint pebbles, many of them rounded, occur at Port MacDonnell and other places, their toughness and resistance to wave action and weathering being so much greater than the rocks in which they occur, that they alone remain, the containing rocks having been disintegrated and removed completely.

"Within the limestone the flints occur as irregular nodules of variable sizes, some of them rounded, others of very variable shapes, including tabular pieces.

"The occurrence inland of raised beaches formed at successive stages of the geological history of the South-East district, suggests the existence, at favourable localities where wave action could sort the flints from the containing limestone, of deposits of flints similar to those found on some of the present beaches. A number of such flint deposits have been found on sites which have proved to be raised beaches.

"The natives therefore appear to have obtained their supplies of flint not only from the beach deposits, but also from the limestones which are the source from which the beach deposits are derived, and also from a number of raised beaches, found inland at distances of as much as fifteen miles and more."

A description of the nature and characteristics of flint and the effect of atmospheric weathering was given in a paper by T. D. Campbell and H. V. V. Noone (1943).

DISCUSSION.

The author made exhaustive enquiries amongst residents in the Mount Gambier district concerning these bi-faced implements, but only one farmer reported having ploughed one up; this was at Square Mile, Mount Gambier. There is an axe in the South Australian Museum collection from Compton, near Mount Gambier. Mr. C. Kurtze informs me that he has never found these artefacts more than 15 miles inland. Such distances may be considered to be well within the range of a coastal tribe. It would appear that the flint implements did not pass along trade routes in the manner ground axes were distributed.

What are the implications of this heterogeneous culture in so small a coastal strip? May it be that here was a tribe with an uninhabited hinterland, who either had brought this bi-face culture with them, or evolved it, being prompted thereto by the type of material so plentifully to hand, and that in course of time, other aboriginals spread over the land, perhaps from the East or North-East, bringing with them ground axes which superseded the implements of flaked flint.

ACKNOWLEDGMENTS.

The author desires to thank Dr. T. D. Campbell for advice on preparing this article; Sub. Lieut. H. M. Cooper, Acting Ethnologist at the South Australian Museum for making available the required specimens; Miss Gwen Walsh, Museum Artist, for her painstaking work in producing the illustrations; and Mr. P. S. Hossfeld, M.Sc., for his notes on the geology of this coastal region.

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ABORIGINAL RELICS NEAR BROKEN HILL

BY A. B. BLACK AND CHARLES FENNER

Summary

In the latter part of 1943, when one of the authors (C.F.) was on a visit to Broken Hill, N.S.W., the other author (A.B.B.) stated that he knew of a site near the Broken Hill Racecourse where there were curious arrangements of stones which he thought might be of aboriginal origin. With Mr. J. F. Paterson, who was also interested, a visit was therefore paid to the area.
Site. The area in question lies about four miles to the north of, and in sight of, Broken Hill, on the right hand side of the Old Main Road from Broken Hill to Stephens Creek, and opposite to the Broken Hill Racecourse. The relics in question consist of a series of what we have called "hearths', arranged in four or more irregular groups, and spread over an area about 60 yards wide from west to east and 450 yards long from south to north. (See plan).

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Plate vi and two text figures.

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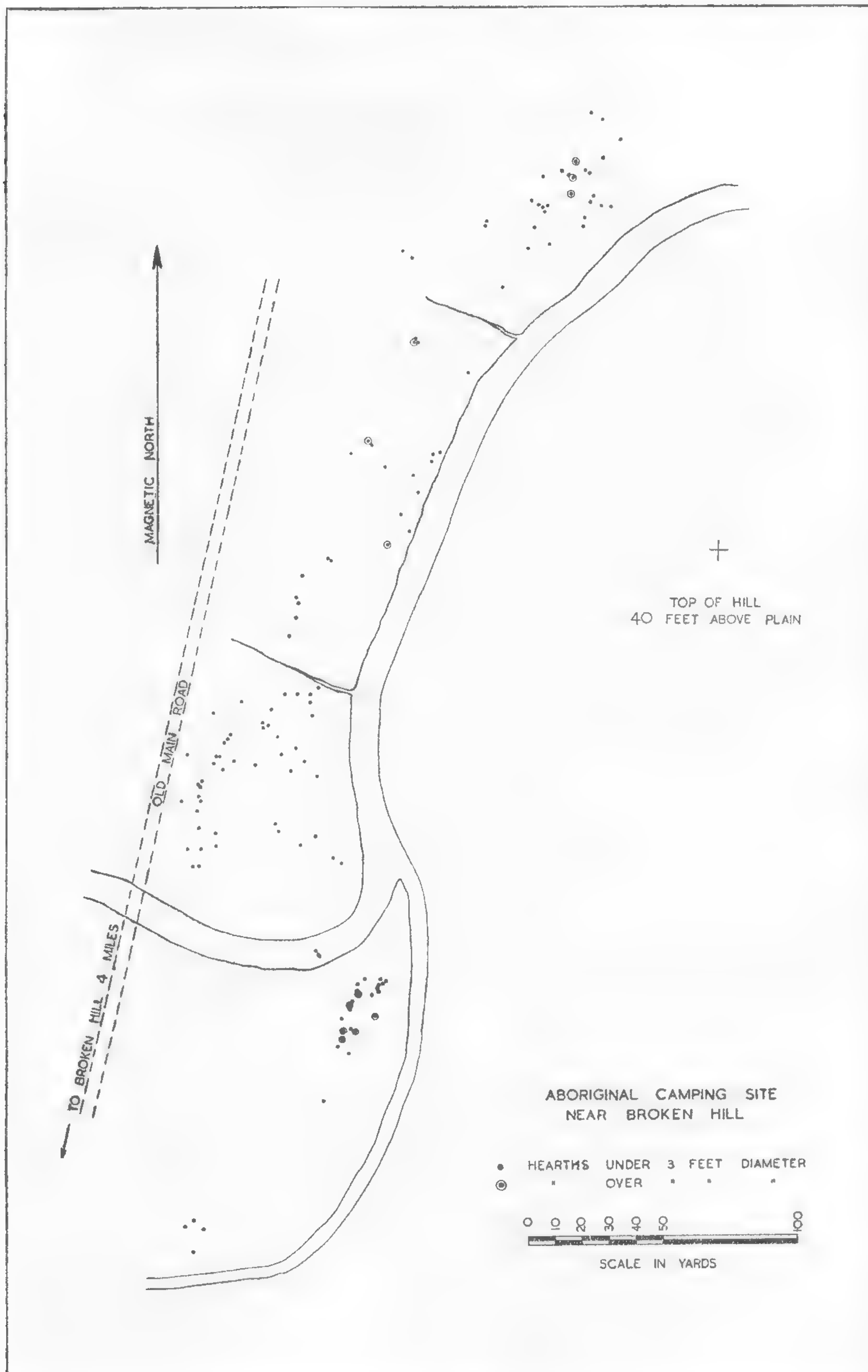
The "hearths" are arranged in somewhat irregular groups along the left side of a small dry stream-bed, cut about 5 or 6 feet deep into red alluvial soil. There are rock bars across the bed of the stream, and it is likely that, in the past, temporary water was obtainable in places in soaks, either in this stream bed or in nearby tributaries. The visit was paid after a fall of rain, and the creek-bed was moist everywhere.

Close by, on the right bank of the stream, there is a small hill of ancient (Pre-cambrian, Willyama series) schistose rocks. The plain on which the aboriginal site occurs widens rapidly to the northward. Standing on the site, one has the impression of a vast and impressive amphitheatre, bounded by the low blue irregular hills characteristic of that district. This "amphitheatre" is not clearly marked on a locality map, but the psychological impression on the spot is quite definite. The point is stressed here because of the possible ceremonial origin of the "hearths."

The hills surrounding the plain are rough, and those to the west behind the racecourse provide gorges in which, according to old inhabitants, rock wallabies were numerous. It would appear that, for short periods after rain, there was water available, animal food in the nearby ranges, emus on the plain, and also wattle trees and spear grass.

"Hearths." The "hearths" are 129 in number, of which 12 are over three feet in diameter. While no one description will cover all the varieties, the best preserved and most impressive consist of collections of from 40 to 50 stones, mostly of flat schistose material, purposefully placed to make a flat mosaic surface, as shown in the photographs. (Plate 1). Some of them are of more irregular and smaller stones, not so close-packed. Also, many that appear to have once been close-packed "hearths" are now dispersed so that they are no more than irregular clusters of stones. The "hearths" vary from 1 foot to 4½ feet in diameter, and are, on account of the special erosive forces of this area, mostly raised a little above the soil. The stones comprising the "hearths" are small, the size varying from 2 inches to 4 inches in maximum length, a few larger. On lifting a stone charcoal can sometimes be seen in the soil that now binds the stones together. The underlying surface is red dry wind-swept alluvium. There are some trees (*Acacia victoriae*) and small blue bushes (*Kochia sedifolia*). Rejuvenation within the adjoining racecourse area suggests that, at one time, the area was fairly well grown with *Acacia victoriae*, etc., which would provide shelter, firewood, and seed.


MAGNETIC NORTH
OLD MAIN ROAD
TO BROKEN HILL 4 MILES
TOP OF HILL
40 FEET ABOVE PLAIN
ABORIGINAL CAMPING SITE
NEAR BROKEN HILL
HEARTHS UNDER 3 FEET DIAMETER
" OVER " " "
0 10 20 30 40 50 100
SCALE IN YARDS

While we have used the term "hearths" for these arrangements of stones, this term cannot be positively justified. The form, the charcoal fragments, and the platform-like character of the best preserved specimens, all suggest this origin. At the same time, as Dr. Campbell has pointed out, they lack certain features of typical native camp-site fire-hearths, particularly in the clustered nature of the

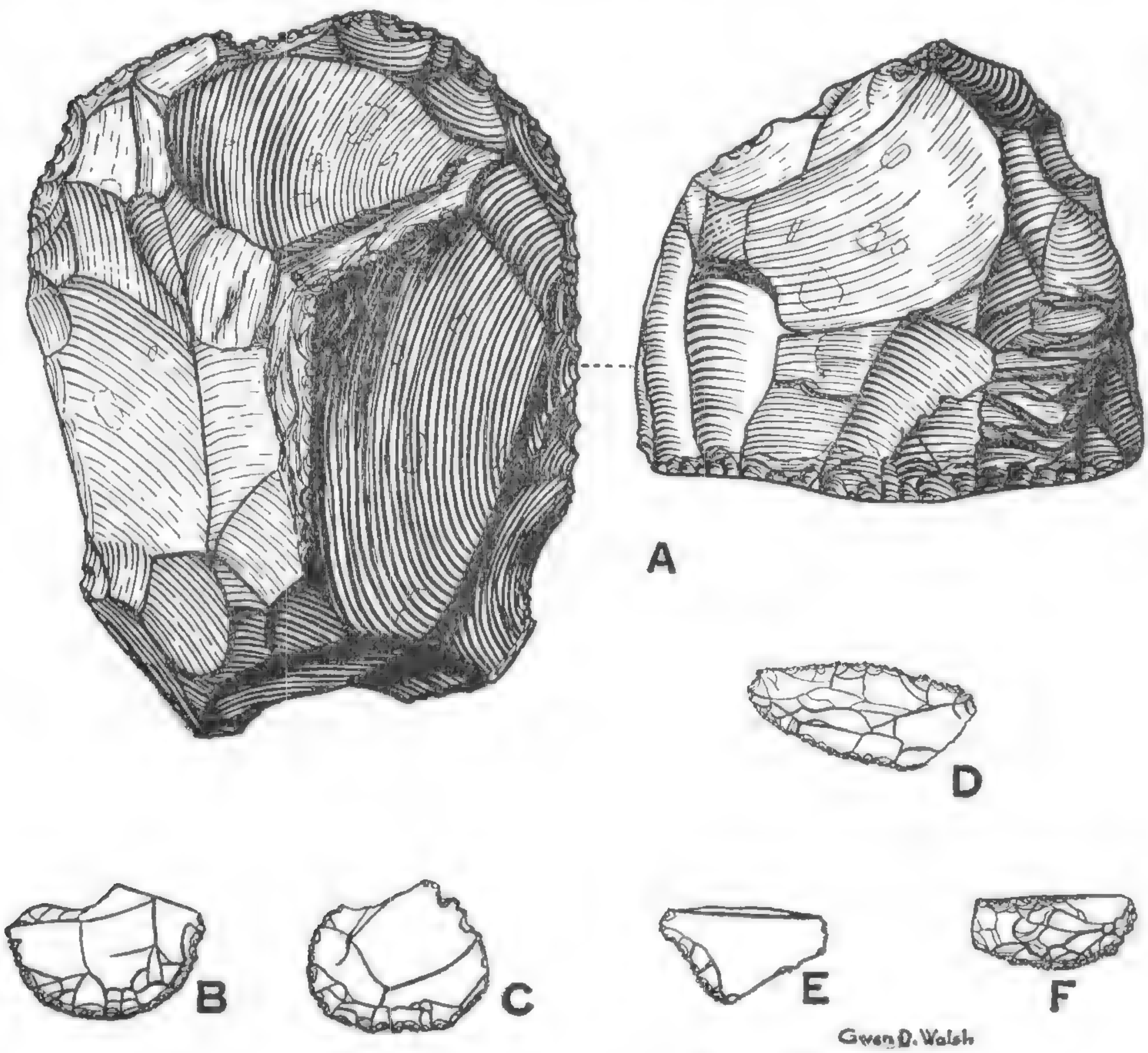


Fig. 1. Stone Implements from Broken Hill.

structures, the absence of the usual low conical mound, and the uncertainty whether all the stones were fire-burned; Dr. Campbell also suggests that the mosaic arrangement may be of ceremonial significance; it is clear from the arrangement of the stones that they are not collapsed piles. Nevertheless, with due caution, the authors believe them to have been fire-hearths, though perhaps in part also ceremonial. The absence of the surrounding mounds may readily be accounted for by the extreme wind erosion of the locality, and the rare but strong rains.

Aboriginal implements. The only visit paid by both authors together was necessarily somewhat brief, but on that visit definite and well-made aboriginal artefacts were found, adjacent to the "hearths", all made of material that must have been transported some distance. In detail the implements were as follows, and some are figured ($5/7$ natural size) herein:

(a) A large hand-implement of the "horse-hoof" type, made of fine-grained yellowish quartzite, containing occasional small quartz pebbles (fig. 1, A).

(b) Four greyish chert implements, of the micro tula type (three shown, fig. 1, B, C, and D).

(c) Two yellowish quartzite implements, of the scraper type.

(d) Ten irregular flaked fragments of quartz, quartzite, and chert (two micro pieces in chert shown (fig. 1, E–F).

A broken grinding stone was later found on the site. The place was no doubt an aboriginal camping place, but the arid character of the district, with occasional torrential rains and frequent strong winds, might well have prevented the development of anything resembling the normal kitchen midden of areas with moister climates.

General. It seems clear that the area was for a long time an aboriginal meeting place and camping ground. It is curious that it so closely adjoins the site of the racecourse, chosen by the modern folk of Broken Hill for their meeting place and recreation.

The amphitheatre, the long-drawn but yet compact area of the "hearths", with the lone hill (watch tower) close by, suggest that the site may have been chosen for ceremonial purposes. It is difficult to imagine that, in so dry a region, the "hearths" were made merely for building fires thereon, though that is conceivable, particularly if the aborigines met there only after rains. It would appear, though the exact evidence for this has not been analysed, that the building of the "hearths" extended over a long period of time.

Of the four groups, the largest "hearths" are those in the southernmost group, and the most abundant are in the second group to the north, where most of the artefacts were found. Having in mind the habits of these primitive people, it is difficult to avoid the idea that some ceremonial and magic was associated with the locality. Both of the authors have wandered a great deal over the areas around Broken Hill, the resident author particularly so, and the latter knows of no other similar extensive arrangement of stones, though he has seen in several places small groups of similar "hearths," not more than 3 or 4 together.

For these reasons, it was considered worth while to make a detailed record of the occurrence. The survey of the area was made by Mr. Black, who is also responsible for the two photographs of the "hearths" reproduced herewith. Thanks are tendered to Dr. T. D. Campbell for comment and advice, and to Miss Gwen Walsh, who kindly drew the line sketches of the artefacts.

EXPLANATION OF PLATE.

Plate vi.

Fig. 1. Typical "hearth" at Racecourse site, Broken Hill; stones mostly schists, mosaic character not much distrubed.

Fig. 2. Another "hearth", relatively compact, but somewhat disarranged. Racecourse site, Broken Hill.

A REVISION OF THE MICROTROMBIDIINAE (ACARINA, TROMBIDIIDAE) OF AUSTRALIA AND NEW GUINEA

BY H. WOMERSLEY, F.R.E.S., A.L.S., ENTOMOLOGIST,
SOUTH AUSTRALIAN MUSEUM

Summary

In the Zool. Anz., 1935, 109 (1/2), 107-112, Sig Thor in reviewing the family Trombidiidae, divided it into ten subfamilies, the sixth of which he called the Ottoniinae, with the genus Ottonia P. Kramer, 1877 (as emended by G. Canestrini, C.F. George and himself) as the type. Later in the same publication (1935, 110, (1/2), 47) he changed the subfamily to Microtrombidiinae with Microtrombidium G. Haller, 1882, as type, on the grounds that Ottonia was preoccupied by Gistel 1848, in the Crustacea and by von Malm, 1873, in the Vermes.
In the Records of the South Australian Museum 1937, 6, (1), 75-100, the present writer reviewed the then known Australian species of Trombidiidae in the light of Sig Thor's studies.

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Fig. 1–38.

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Since that time much more material has come to hand, including some from New Guinea, and a further revision of the family is needed. In the present paper, however, only the subfamily Microtrombidiinae is dealt with and that only as far as the adults or nymphs are concerned, the larval stages being very little and inadequately known.

The genus *Microtrombidium* Haller was first split by Berlese (Redia, 1912), into *Enemothrombium* and *Microtrombidium* s. str. the latter with two subgenera *Dromeothrombium* and *Microtrombidium*, on the structure of the dorsal setae, *Enemothrombium* being restricted to a heterogeneous lot of species with very variable types of dorsal setae but all of which differed from the simple, more or less pennate type found in *Microtrombidium* and *Dromeothrombium*.

In 1916 A. Krause (Zool. Anz., 47, 97, fig. 1–6) erected from the *Enemothrombium* complex, the genus *Campylothrombium* for those species in which the dorsal setae were of uniform length, clavate, septate and decumbently curved. Sig Thor in 1936 (Zool. Anz. 114, 30) went a stage further and placed Berlese's *M. perligerum*, in which the setae are uniformly short and tree-like with intertwining branches, in a new genus *Dendrotrombidium*. *M. vagabundum* (Berl. 1903) he made the type of *Platytrombidium* n.gen. in which the dorsal setae are short, flat and broad, generally triangular and pointed, and fusiform with fine ciliations. He included here several other species. For *M. pexatum* (Koch, 1837) (= *calycigerum* Berl. 1910) he erected the genus *Camerotrombidium*, in which the larger dorsal setae at least, were erect, globose, septate and chambered, generally short and papilliform. In this genus he included *C. collinum* (Hirst, 1928), *simile* (Hirst, 1928), and *hirsti* (Wom., 1934) all from Australia.

In 1937 Womersley (Rec. S. Aust. Mus., 6, (1), 83) erected the genus *Echinothrombium*, with *O. spinosum* Canest., 1877, as type, for those species in which some or all of the dorsal setae are spine-like with or without short ciliations. Included here were several Australian species. Berlese's *M. (E.) eutrichum* was, in the same paper, made the type of a new genus *Eutrichothrombium* in which the dorsal covering consists of closely packed, globose, non-septate setae, interspersed with longer fine setae. A new genus *Laminothrombium*, with the dorsal setae as uniformly short, pointed, leaf-like laminae with strong mid-rib and marginal ciliations, was made for a new Australian species *L. myrmicum*. Amongst the genera

included by Sig Thor, 1935 (*loc. cit.*) and also by Womersley, 1937, in this subfamily were *Calothrombium* Berl., 1918, and *Neotrombidium* Leonardi, 1901. The first of these, however, has a very different type of crista, which conforms with that figured by Berlese (1912) for the genus *Tanaupodus* Haller, 1882, and *Calothrombium* (type *C. paoli* Berl.) must therefore be assigned to Sig Thor's Tanaupodinae.

The genus *Neotrombidium* also differs widely from the Microtrombidiinae in that the crista is enlarged anteriorly into a more or less triangular area or nasus, in this respect showing homology with that which I have found recently in the nymphs of the genus *Leeuwenhoekia* (*Acomatacarus*). *Neotrombidium* must therefore, be removed from the Microtrombidiinae.

The genus *Mauriquia* with *M. bequaerti* B. & K. as type has recently been erected (1942, Rev. Acad. Columbiana d. Ci. Exact, Bogota, 17, 110-127) by J. Boshell and J. A. Kerr for six species of Microtrombidiinae from Columbia, South America. In the generic description the features stressed are (1) crista anteriorly rod-like with a subposterior sensillary area, (2) palpal tibia with strong claw, smaller accessory claw, two pectines, and an external spine, and (3) the dorsal setae of varied forms. Now these characters are those found in *Microtrombidium* (Haller, 1882, s.str.), with *pusillum* Hermann, 1804, as type, except that while generally present, the external spine of the palpal tibia is absent in *pusillum* and one or two other species; this, however, hardly justifies a generic separation.

In the same paper Boshell and Kerr also describe a number of species of *Microtrombidium* s.l., which in the varied and different forms of dorsal setae, fit into several of the genera into which *Microtrombidium* s.l. in the present paper is divided. Even the species included in *Mauriquia* by the authors, belong to several of these genera, including *Microtrombidium* s.str.

In *Microtrombidium* s.str. should be placed *Mauriquia rocae* B. & K., *samperi* B. & K., and ? *bolivarensis* B. & K., and also *Microtrombidium wilsoni* B. & K., and *kumpi* B. & K. In the genus *Echinothrombium* should be included *Mauriquia bequaerti* B. & K., *Microtrombidium duartei* B. & K., and *bugheri* B. & K.

Microtrombidium arborealis B. & K. and *acuna* B. & K. would seem to belong to *Camerotrombidium* while *Microtrombidium soperi* B. & K. would be a *Foliotrombidium*, and *cararensis* possibly a *Hiotrombidium*. *Mauriquia restrepoi* B. & K. and *mauriquia* B. & K. may be placed in *Holcotrombidium*.

Boshell and Kerr in their paper also describe the larvae reared from eggs laid by a captured adult *Mauriquia bequaerti*. From the description and figure given the larva comes close to those described by Oudemans (1912) as belonging to the genus *Parathrombium* Bruyant, 1910. It is also somewhat similar, except that the chelicerae are free and not enclosed in a chitinous dentate ring and that the claws of the third leg are normal, not deformed, to the larvae of *Camerotrombidium simile* (Hirst) described in the present paper.

The present paper is the first of a series in which it is intended to critically review the adult species of Trombidiidae of Australia and New Guinea. The latter area is included, as amongst new material available there are a number of species, collected in that area by Maj. G. M. Kohls of the American Scrub-typhus Commission, which can be referred to some of those described, very inadequately, by Canestrini in 1889.

In the Microtrombidiinae as restricted herein, it is shown that, following the work of Berlese and Sig Thor, good generic characters are to be found in the types of dorsal setae; the form of the crista and of the palpal tibia being of subfamily value. Specific characters are to be found in the dimensions of the front tarsi and metatarsi and in the lengths and degrees of ciliation of the dorsal setae, etc.

A key to the genera considered as falling into this subfamily is given

FAMILY TROMBIDIIDAE Leach 1814.

SUBFAMILY MICROTROMBIDIINAE Sig Thor, 1935 (Jan.).

= OTTONIINAE Sig Thor, 1934, Nov. (1935).

Emended Description.

Body size small to moderate. Shape more or less cordate, often with well defined shoulders to hysterosoma, propodosoma usually triangular, its base slightly narrower than hysterosoma, latter slightly tapering with rounded posterior. A distinct suture line between propodosoma and hysterosoma. Crista linear, without any enlarged triangular or subtriangular anterior area or nasus[1], with a roundish subposterior areola-like sensillary area furnished with a pair of long filamentous sensillae. Eyes usually present, 2 + 2, on well developed sessile or subsessile ocular shields. Palpi generally stout, tibia with stout apical claw, smaller accessory claw, two pectines and usually 1 or more strong spines on external side; tarsus usually elongate. Dorsal setae very variable, simple, or spine-like, pennate, clavate, septate or of curious forms, often of two distinct sizes or forms.

Genotype: *Microtrombium* G. Haller, 1882.

KEY TO THE GENERA (ADULT) OF THE MICROTROMBIDIINAE SIG THOR 1935.

1. Legs I and IV very much longer than the body, I much stouter than the others. Shoulders prominent. Eyes 2 + 2, sessile. Palpal tibia fairly slender in distal portion, with strong apical claw, with or without smaller accessory claw, with pectines but without external spines. Dorsal setae, more or less pennate or with long setules, of uniform or variable length *Dromeothrombium* Berl. 1912.
   Legs I and IV not, or only slightly longer than the body 2
2. With two kinds of dorsal setae, of which the longer are stiff and spine like, with or without short setules or serrations .. .. 3.
   If with two kinds or lengths of dorsal setae then the longer ones are not stiff and spine-like 4.
3. The smaller dorsal setae pennate, or stiff with long ciliations. Palpal tibia with one strong external spine .. .. *Echinothrombium* Wom. 1937.
   Smaller dorsal setae spathulate, with long ciliations or short denticles. Crista posterior of sensillary area evanescent. Palpal tibia without external spine *Spathulathrombium* nov.
4. Dorsal setae, even if of two different lengths, pennate, or as slender rods with long ciliations *Microtrombidium* Haller 1882 s. str.
   Dorsal setae of varying forms but not as above .. .. 5.
5. At least the larger dorsal setae septate and chambered .. .. .. 6.
   No dorsal setae septate .. .. 7.
6. Dorsal setae uniform, slender, clavate, septate, and decumbently curved *Campylothrombium* Krausse 1916.
   Larger dorsal setae globose or thistle-like, septate, upright and not curved or decumbent; smaller setae variable .. .. *Camerotrombidium* Sig Thor 1936.
7. Dorsal setae mainly globose and tightly packed, but with some fine simple longer setae interspersed .. .. *Eutrichothrombium* Wom. 1937.
   Dorsal setae otherwise .. .. 8.
8. Dorsal setae small, uniform, tree-like with fine intermingling branches. Palpal tibia with external spine .. .. *Dendrotrombidium* Sig Thor 1936.
   Dorsal setae otherwise .. .. 9.
9. Dorsal setae thin and lamellate, or scale-like, often with the margins incurved, sometimes so much so as to form a sort of helmet .. .. 10.
   Dorsal setae otherwise .. .. 12.
10. Dorsal setae with the margins not incurved, foliate .. .. 11.
    Dorsal setae with the margins more or less incurved, sometimes strongly so, the setae being helmet-like .. .. *Holcotrombidium* nov.

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[1] The anterior rounded or sinuated apex of the propodosoma may be a more or less lightly chitinized transverse plate appearing as part of the crista as in *E. echidninum* but there is no true anteriorly projecting nasus.

11. Dorsal setae thin, pointed, leaf-like with strong mid-rib and marginal ciliations *Laminothrombium* Wom. 1937
Dorsal setae thin, blunt and rounded at apex, more or less scale-like *Foliotrombidium* nov.
12. Some or all the dorsal setae bifid, either from the base or apically .. .. 13.
Dorsal setae simple, solid, blunt or pointed apically .. .. 14.
13. Dorsal setae thick stemmed with long ciliations and frequently bifid near apex, the branches appearing clavate .. .. *Georgia* Hull 1918.
Dorsal setae bifid from the base, the two branches forming more or less concave opposed lips *Hiotrombidium* nov.
14. Dorsal setae, sometimes only the smaller, fusiform, apically acute with short ciliations .. 15.
Dorsal setae otherwise, blunt or only obtusely pointed at apex *Enemothrombium* Berl. 1912 s. str.
15. Median segments of legs I and IV produced laterally at apex into strong irregularly dentate processes. Coxae IV set at right angles to III, so that legs IV are splayed outwards *Pedotrombidium* nov.
Legs normal, dorsal setae fusiform and pointed with short ciliations *Platytrombidium* Sig Thor 1936.

Genus Dromeothrombium Berl. 1912.

Redia 8, (1), 132, fig. 59.

Berlese erected *Dromeothrombium* as a subgenus of *Microtrombidium* for his species *M. macropodum* from Java, on the character of the first and fourth legs being very much longer than the body.

In 1937 (Rec. S. Aust. Mus., 6, (1), 86) I placed Banks's *Rhyncholophus attolus* from New South Wales, (and earlier (Womersley, 1934) as *Microtrombidium*) in *Dromeothrombium*; in 1939 (Tr. Roy. Soc. S. Aust., 63 (2), 150) I recorded *D. macropodum* from Queensland, and described *D. dromus* from South Australia.

Upon re-examination of this material I now find that, while agreeing in the long first and fourth legs with the genotype, *macropodum*, the species *attolus* and *dromus* are generically distinct in that the crista has a small but distinct subtriangular anterior area or nasus, that the accessory claw of the palpal tibia is wanting, but that there are instead 2–3 stout spines, and that there are no pectines on this segment of the palpi.

These two species must then be withdrawn, not only from the genus but also from the subfamily Microtrombidiinae and will later be referred to a new genus and family. The Queensland specimens are now recognized as distinct from *macropodum* and renamed *queenslandiae*.

The genus can be defined as follows:

> Legs much stouter than the rest, I and IV longer than the body. Shoulders very prominent. Eyes 2+2, sessile, on ocular shields. Crista linear, with subposterior sensillary area and paired sensillae, anterior area absent, no nasus. Palpi relatively stout, tibia with strong apical claw, accessory claw, and two pectines but in known species without external spine.

Genotype *D. macropodum* Berl., 1912. Also *D. queenslandiae* nov. nom. for *macropodum* Wom., 1939, *nec* Berl.

Dromeothrombium queenslandiae nom. nov.

=*D. macropodum* Wom., 1939, *nec.* Berl.

Fig. 1 A–D.

Redescription. Colour in life probably white. Shape cordiform with prominent shoulders. Length 0·9 mm., width across shoulders 0·72 mm. Legs relatively thick, especially I; length of leg I 1575μ, II 1020μ, III 1020μ, IV 1875μ; tarsus I elliptical, 375μ long by 190μ high, metatarsus I 225μ long. Crista linear, 396μ

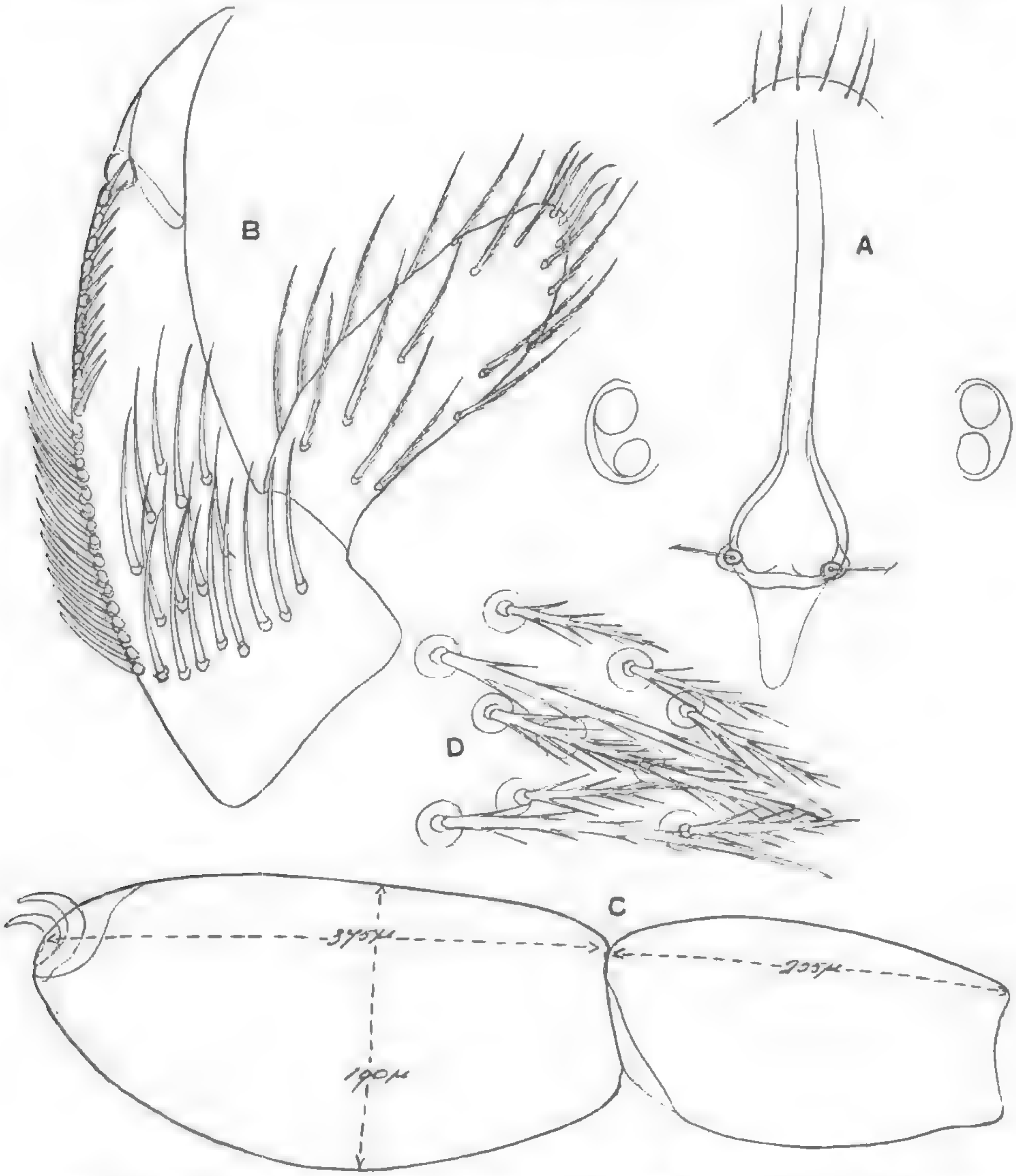

Fig. 1. *Dromeothrombium queenslandiae* sp. n. A, Crista and eyes (× 200); B, palpal tibia and tarsus (× 200); C, front tarsus and metatarsus (× 200); D, dorsal setae (× 860).

long, with subposterior sensillary area with sensillae apparently nude and ca. 126μ long, their bases 54μ apart. Palpi as figured (1 B), tibia as in subfamily with strong apical claw, smaller accessory claw, two well defined pectines but no external spines; tarsus elongate and reaching tip of claw. Dorsal setae as in fig. 1 D, with strong setules and of two different lengths, 25–30μ and 64μ, the longer setae being fewer in number and with rather shorter setules.

Loc. Only known from the original two adults, collected in Queensland in 1939 by Dr. W. G. Heaslip, one from Cairns in March, the other from Innisfail in December.

Remarks. The genotype *D. macropodum* Berl., 1903 (Redia, 2, 153, pl. 15, fig. 3; Redia, 1912, 8, 132–3, text fig. 59) was from Java. Berlese only figured

the entire dorsal surface and an enlarged dorsal seta. Vitzthum (Treubia, 1926, 8, 136–7, fig. 80 and 81) described an adult from Buitenzorg and gave figures and detailed measurements of the palpal tibia and front tarsus and metatarsus.

The present species differs from the genotype in (1) the presence of a distinct accessory palpal claw, (2) the much greater height of the front tarsus as compared with the length, and (3) the different form of the dorsal setae, which are of two sizes, 25–30μ and to 64μ as compared with uniform, 20–30μ long in *macropodum*.

Genus Echinothrombium Womersley, 1937.

Rec. S. Aust. Mus. 6 (1), 89.

Manriquia Boshell and Kerr, 1942 (in part), Rev. Acad. Columb. Ci. Ex., 5, 110–127.

Microtrombidium Boshell and Kerr *ibid.* (in part).

This genus was raised in 1937 for those species of *Microtrombidium* s.l. in which the longer of the dorsal setae are stiff and spine-like with or without short ciliations or serrations. The type designated was *Ottonia spinosa* Canestrini, 1877, and other species were *M. echidninum* Hirst, 1931 (= *victoriense* Wom., 1934), *M. spinatum* Wom., 1934, *M. hystricinum* Canest., 1889, *M. diversipile* Canest., 1889, *M. southcotti* Wom., 1934, and *M. willungae* Hirst, 1931.

Of these species, *southcotti* has the smaller dorsal setae spathulate with fine ciliations, all the other species having these smaller setae of the pennate type or stiff with long cilations. Other species with the spathulate type of microsetae are herewith described, and together with *southcotti* separated off as a new genus *Spathulathrombium.*

The genus *Echinothrombium* may be diagnosed as follows:

> As in *Microtrombidium* but with two kinds and lengths of dorsal setae, one short and pennate, or stiff with rather long ciliations; the other long, stiff and spine-like with acute apex and with short ciliations, indistinct serrations or quite smooth. Eyes 2+2, on ocular shields. Apex of propodosoma sinuate, frequently in well chitinized specimens with a transverse ill-defined plate adjoining tip of crista. Crista linear with subposterior sensillary area with paired filamentous sensillae. Palpi stout, tibia as in subfamily, with a single spine on external surface. Body shape elliptical with only moderately pronounced shoulders. Legs I and IV not or not much longer than body.

Echinothrombium echidninum (Hirst, 1931).

Microtrombidium echidninum Hirst, 1931, P.Z.S., 561; Womersley, 1937, Rec. S. Aust. Mus., 6 (1), 90.

M. (Enemothrombium) victoriense Womersley, 1934, Rec. S. Aust. Mus., 5 (2), 195.

Echinothrombium echidninum, Womersley, 1937. Rec. S. Aust. Mus., 6 (1), 90.

Fig. 2 A–E.

Redescription. Colour in life uniformly red. Body oval, broadest across the shoulders. Length 2·6 to 3·0 mm., width 1·2 to 1·5 mm. Legs I 2250μ long, II 1725μ, III 1650μ, IV 2500; tarsus I 270μ high by 630μ long, metatarsus I 465μ long, for specimen of 3·0 mm. in length. Eyes 2+2, sessile. Crista as figured, 645μ long with sensillary area at about ⅘ from anterior end; sensillae bases 61μ apart with sensillae ca. 150μ long and apparently nude. Mandibles with inner margin of chelicerae finely serrate. Palpi as in generic diagnosis, tarsus not

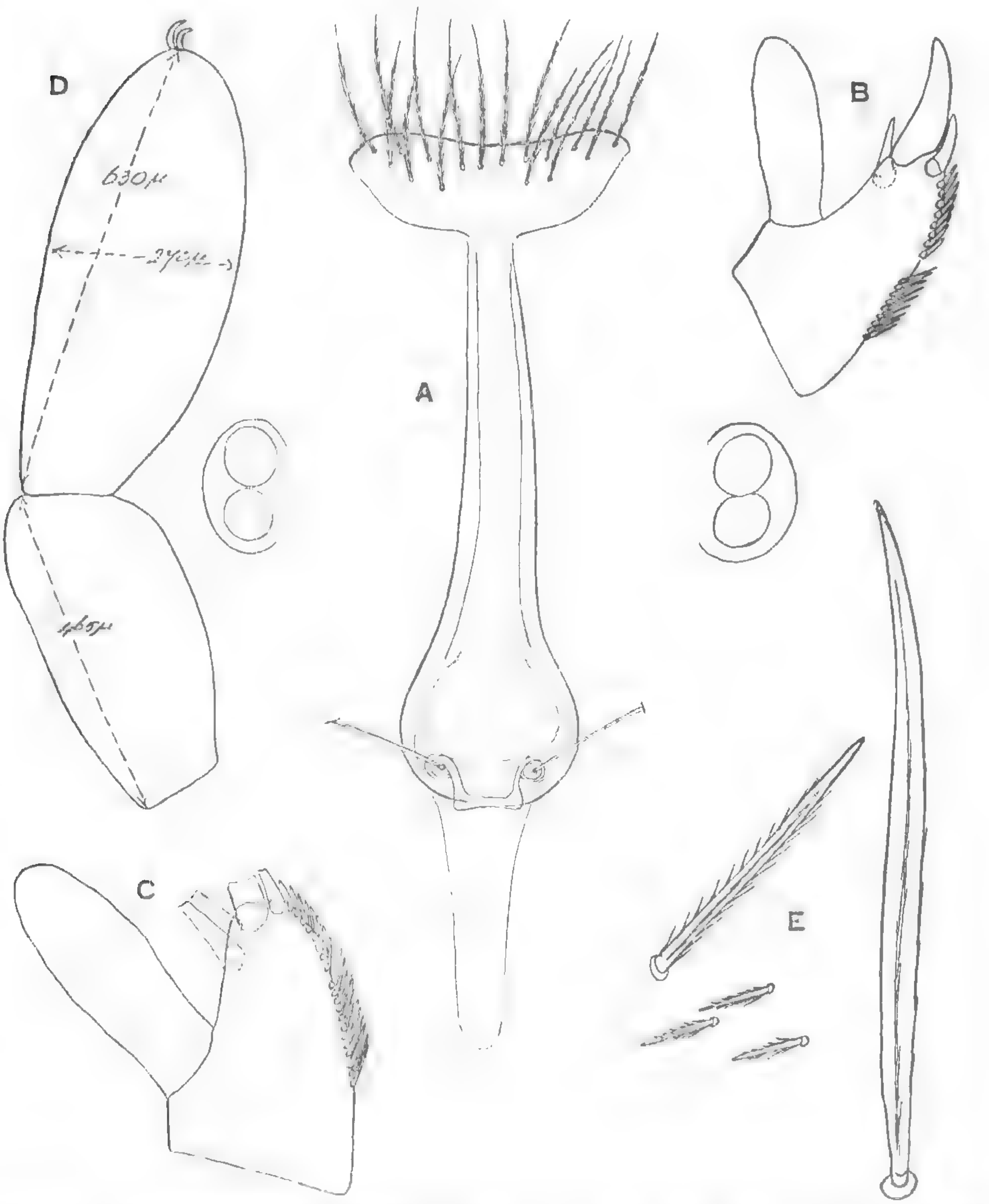

Fig. 2. *Echinothrombium echidninum* (Hirst). A, Crista and eyes (× 200); B, palpal tibia and tarsus (× 200); C, same of Hirst's type (× 200); D, front tarsus and metatarsus (× 87); E, dorsal setae (× 860).

reaching tip of tibial claw. In Hirst's type, as he states, there are two strong external spines on the palpal tibia, but only one in all my specimens (cf. fig. 2 B and C). Smaller dorsal setae pointed, 18-29μ long, and with short setules; longer setae to 220μ in length, many of which appear nude but in reality have rows of short adpressed setules as in fig. 2 E; between these extremes are some setae of intermediate length, ca. 108μ, on which there are distinct setules.

Loc. Hirst's type specimen, in the S. Aust. Mus. was from Mt. Gambier, S. Aust. I have additional material from South Australia: Flinders Chase, Kangaroo Is., Dec., 1934; Victoria: Sassafras 1931, Olinda 1940.

ECHINOTHROMBIUM WILLUNGAE (Hirst, 1931).

Microtrombidium willungae Hirst, 1931. P.Z.S., (1), 562.

Microtrombidium spinatum Womersley, 1934. Rec. S. Aust. Mus., 5 (2), 192.

Echinothrombium spinatum Womersley, 1937. Rec. S. Aust. Mus., 6 (1), 89.

Echinothrombium willungae, Womersley, 1937, *ibid.*, 89.

Fig. 3 A–E.

In the original description of *spinatum* the dorsal setae were stated to be all of the one type. They are, however, of two very different lengths, although much of the same type. A careful comparison of the type with the description

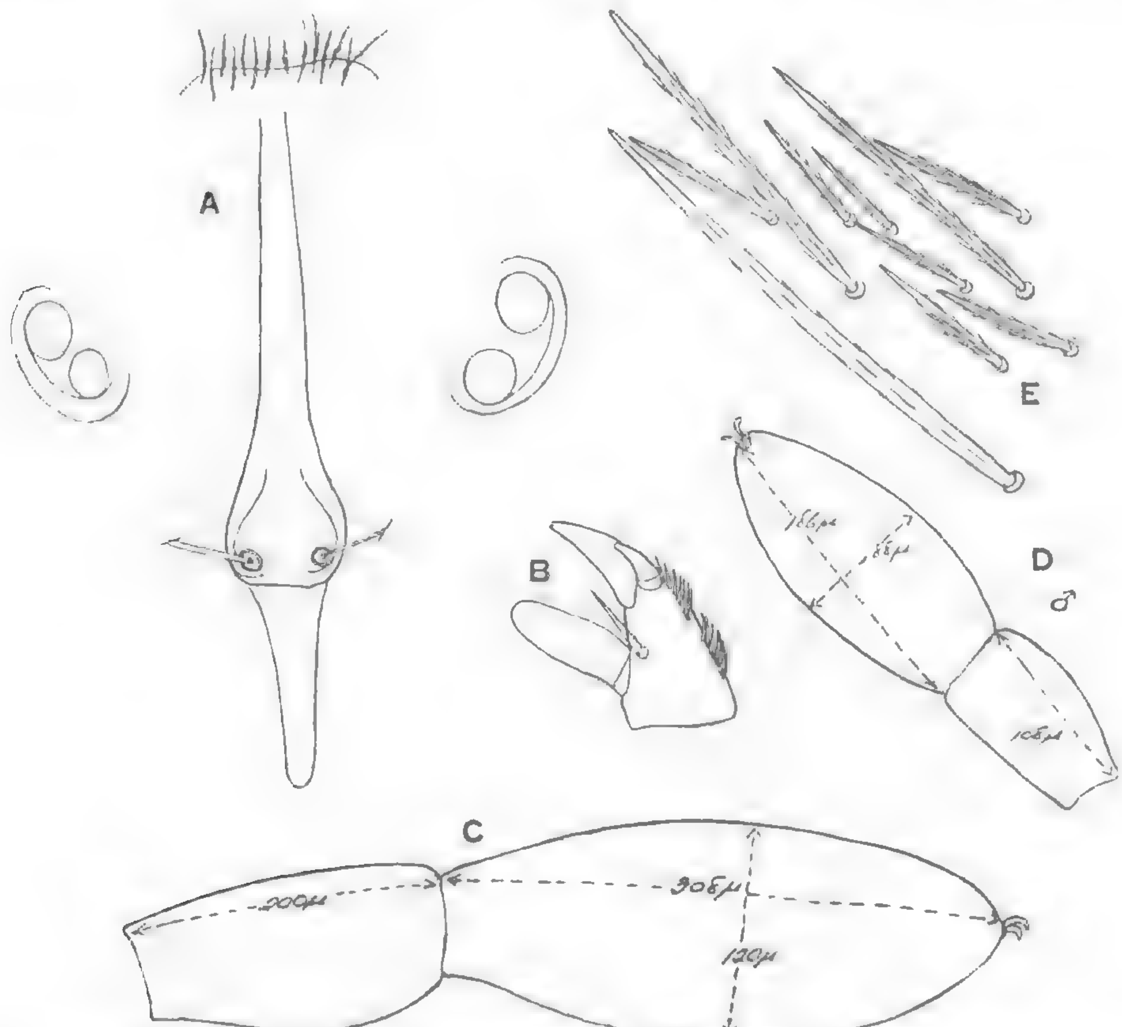

Fig. 3. *Echinothrombium willungae* (Hirst). A, Crista and eyes (× 200); B, palpal tibia and tarsus (× 200); C, front tarsus and metatarsus ♀ (× 200); D, same of ♂ (× 200); E, dorsal setae (× 860).

of Hirst's *willungae* and with specimens of the latter from many South Australian localities shows that *spinatum* is co-specific with *willungae* and must therefore sink as synonymous with it.

This species is, as stated by Hirst, closely related to *echidninum* from which it differs in the dimensions of the front tarsi and metatarsi and in the different dorsal setae. In *willungae* the smaller dorsal setae are longer than in *echidninum*,

of rather different form and do not constitute the major portion of the dorsal clothing. The larger setae do not reach the lengths of those found in *echidninum* and they are all distinctly ciliated or setulate. Intermediate sizes also occur.

The following redescription is drawn from a specimen from Rivervale, South Australia. In the dimensions of the front tarsi and metatarsi the extremes and average of nine specimens are given:

Redescription. Length to 2·1 mm., width across shoulders to 1·275 mm. Shape as in *echidninum*. Legs shorter than body, I 1275μ, II 930μ, III 945μ, IV 1125μ; tarsi I 292–315μ (aver. 308μ) long, 101–130μ (aver. 120μ) wide, metatarsi I 182–210μ (aver. 201μ) long. Eyes 2 + 2, sessile, well away from crista and in advance of sensillary area. Crista as figured, 480μ long, with sensillary area at about ⅗ from apex, sensillae ca. 120μ long, apparently nude and with bases 34μ apart. Chelae with inner edge serrate. Palpi as figured, tarsus elongate but not over-reaching tip of palpal claw, tibia with one long slender external spine well separated from base of claw.

Dorsum thickly covered with spine-like setae; generally of two distinct lengths, but with some intermediate; all with distinct ciliations or setulations except at the tips which are pointed and more chitinized; short setae 35–45μ long, longer setae to 150μ long.

Loc. Hirst's type was from Willunga, South Australia, Oct. 1929. I have further specimens from the following South Australian localities: Glen Osmond, Oct. 1933, Long Gully, May 1934, Mt. Osmond and Mt. Lofty, June 1934, Burnside, Aug. 1934, Rivervale, April 1934, Belair, May 1935 and March 1938.

All the above specimens in possessing three pairs of genital discs are adult and probably all females. Two other specimens, one from Mt. Lofty, S. Aust., June 1934, and one from Fern Tree Gully, Victoria, Jan. 1937 agree in the nature of the dorsal setae but are considerably smaller in size and dimensions of front tarsi and metatarsi and crista, etc., as follows:

From Mt. Lofty.

Length 675μ, width 420μ. Legs I 675μ, II 470μ, III 440μ, IV 675μ; tarsus I 186μ by 86μ, metatarsus I 105μ. Crista 195μ long. Sensillae ca. 130μ long and bases 23μ apart. Dorsal setae 30–40μ and to 100μ.

From Fern Tree Gully:

Length 675μ, width 450μ. Legs I 660μ, II 420μ ca., III 450μ, IV 600μ; tarsus I 189μ by 90μ, metatarsus I 110μ. Crista 190μ long. Sensillae ca. 126μ long and bases 25μ apart. Dorsal setae 30–40μ and to 110μ.

Despite the differences in the relative proportions of the tarsal dimensions, which might only be sexual, these specimens must, I believe, be regarded as males. In having three pairs of genital discs they are adults.

ECHINOTHROMBIUM BARDONENSE sp. nov.

Fig. 4 A–D.

Description. Colour red. Shape roughly elliptical with moderately prominent shoulders. Length to 2·025 mm., width to 1·275 mm. Legs fairly stout, I 2100μ long, II 1350μ, III 1275μ, IV 2250μ; tarsi I elliptical 450μ long by 210μ high, metatarsi I 330μ long. Crista linear as figured, 380μ long, with subposterior sensillary area, sensillae ? length, bases 36μ apart. Eyes 2 + 2, on distinct subsessile ocular shields. Palpi as figured, tibia with one slender external spine, tarsus rather elliptical, reaching tip of tibial claw. Dorsal setae of two kinds and lengths, the smaller pointed, rod-like, 40–55μ long, with distinct ciliations; the larger spine-like, to 240μ long, with strongly chitinized and pigmented pointed tips, apparently quite nude.

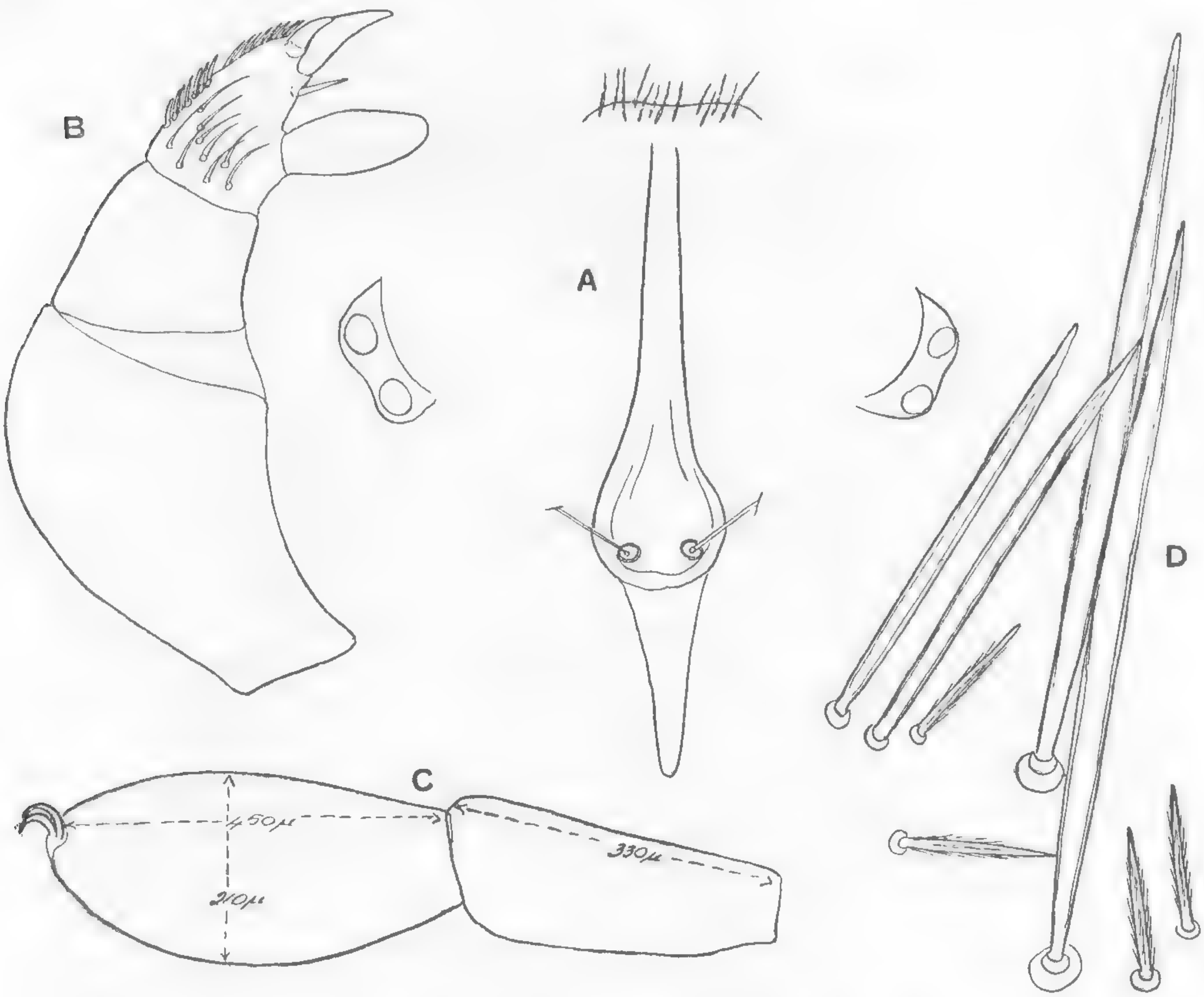

Fig. 4. *Echinothrombium bardonense* sp. n. A, Crista and eyes (× 200); B, palp (× 200); C, front tarsus and metatarsus (× 87); D, dorsal setae (× 860).

Loc. Two specimens from Bardon, Queensland, Aug. 1943 (N.B.T.).

Remarks. Close to *echidninum* and *willungae* but differing in the dorsal setae and the proportions of the front tarsi and metatarsi.

ECHINOTHROMBIUM LAMINGTONENSIS sp. nov.

Fig. 5 A–D.

Description. Adult. Colour red. Shape elliptical, rather broader across shoulders. Length 1·8 mm., width 1·25 mm. Legs not longer than body, I 1725μ, II 1080μ, III 1080μ, IV 1500μ tarsus I as figured, 405μ long by 135μ high, metatarsus I 315μ long. Crista as figured 380μ long with broad sensillary area at about ⅔ from apex, sensillae approximately 200μ long, apparently nude and with their bases 32μ apart. Eyes 2+2, sessile, on distinct ocular shields and in advance of sensillary area. Mandibles with inner edge of chelicerae finely serrated. Palpi as figured, tibia with one long, pointed, external spine; tarsus elongate, not or only indistinctly clavate and not over-reaching tip of claw.

Loc. A single specimen from the Lamington National Park, Queensland. Sept. 1941 (A.R.B.).

Remarks. Close to the two preceding species but distinct in the form of the smaller dorsal setae and the dimensions of the front tarsi and metatarsi.

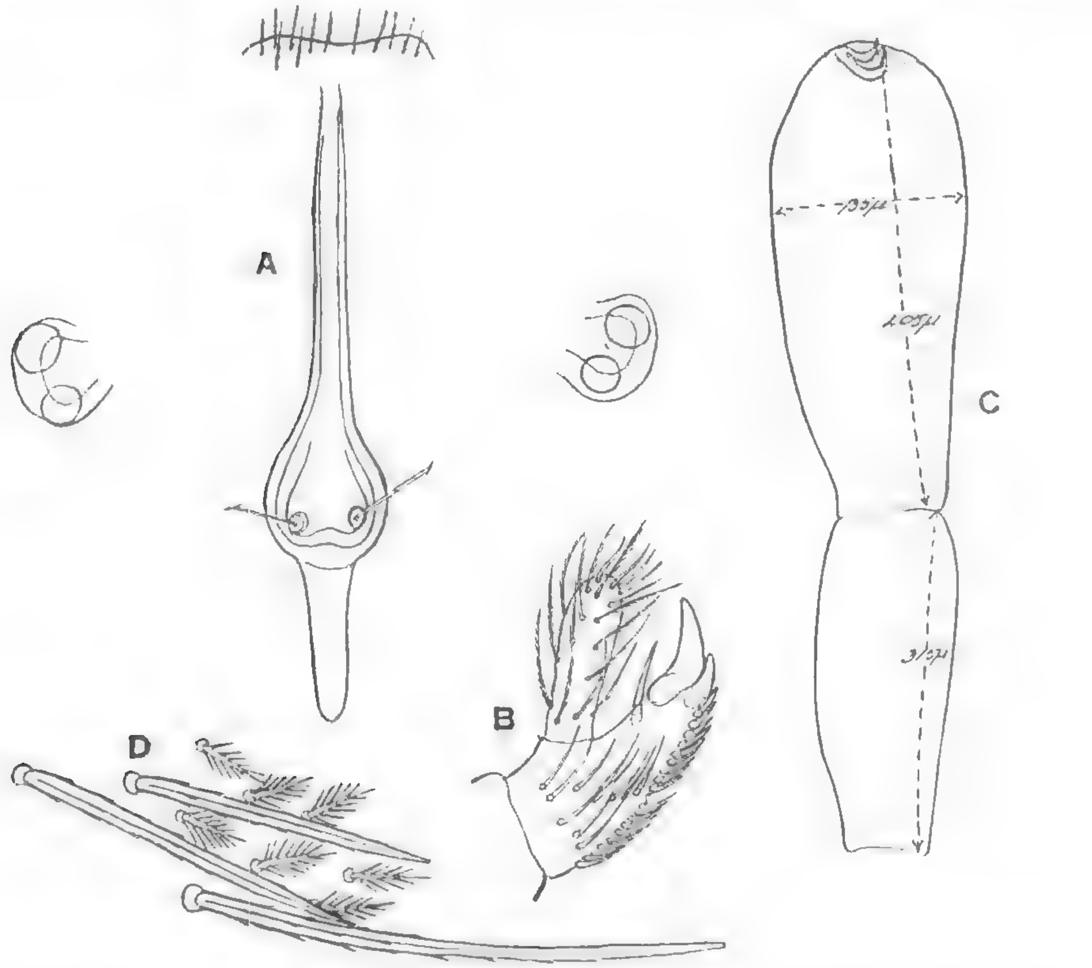

Fig. 5. *Echinothrombium lamingtonensis* sp. n. A, Crista and eyes (× 200); B, palpal tibia and tarsus (× 200); C, front tarsus and metatarsus (× 125); D, dorsal setae (× 860).

KEY TO THE AUSTRALIAN SPECIES OF *Echinothrombium* (ADULTS).

1. Dorsal microsetae pennate with long outstanding setules, 18–40μ long; macrosetae spine-like with sparse short setules, 180–220μ long. T_1 elongate, 405μ by 135μ, M_1 315μ. *lamingtonensis* sp. nov.
   Dorsal microsetae not pennate, more or less rod-like and with only short adpressed setules .. 2.
2. Microsetae of dorsum much less than one-third length of macrosetae .. .. 3.
   Microsetae about one-third length of macrosetae, 25–45μ as compared with 150μ, Macrosetae with short setules. T_1 300μ by 120μ. M_1 195μ (adult ♀) .. *willungae* (Hirst).
3. Macrosetae quite nude, to 240μ long; microsetae 40–50μ. T_1 450μ by 210μ. M_1 330μ *bardonense* sp. nov.
   Macrosetae with sparse but distinct setules, to 220μ long; microsetae 20–30μ long. T_1 630μ by 270μ. M_1 460μ .. .. *echidninum* (Hirst.).

Genus SPATHULATHROMBIUM nov.

As in *Echinothrombium* with the larger dorsal setae long and spine-like, but the smaller setae spathulate with ciliations or setules. The posterior arm of the crista very evanescent, almost invisible, so that the sensillary area appears to be posterior. In all known species the palpal tibia without any external spine, distal portion of tibia slender, about twice as long as basal part.

Genotype: *M. southcotti* Wom., 1934.

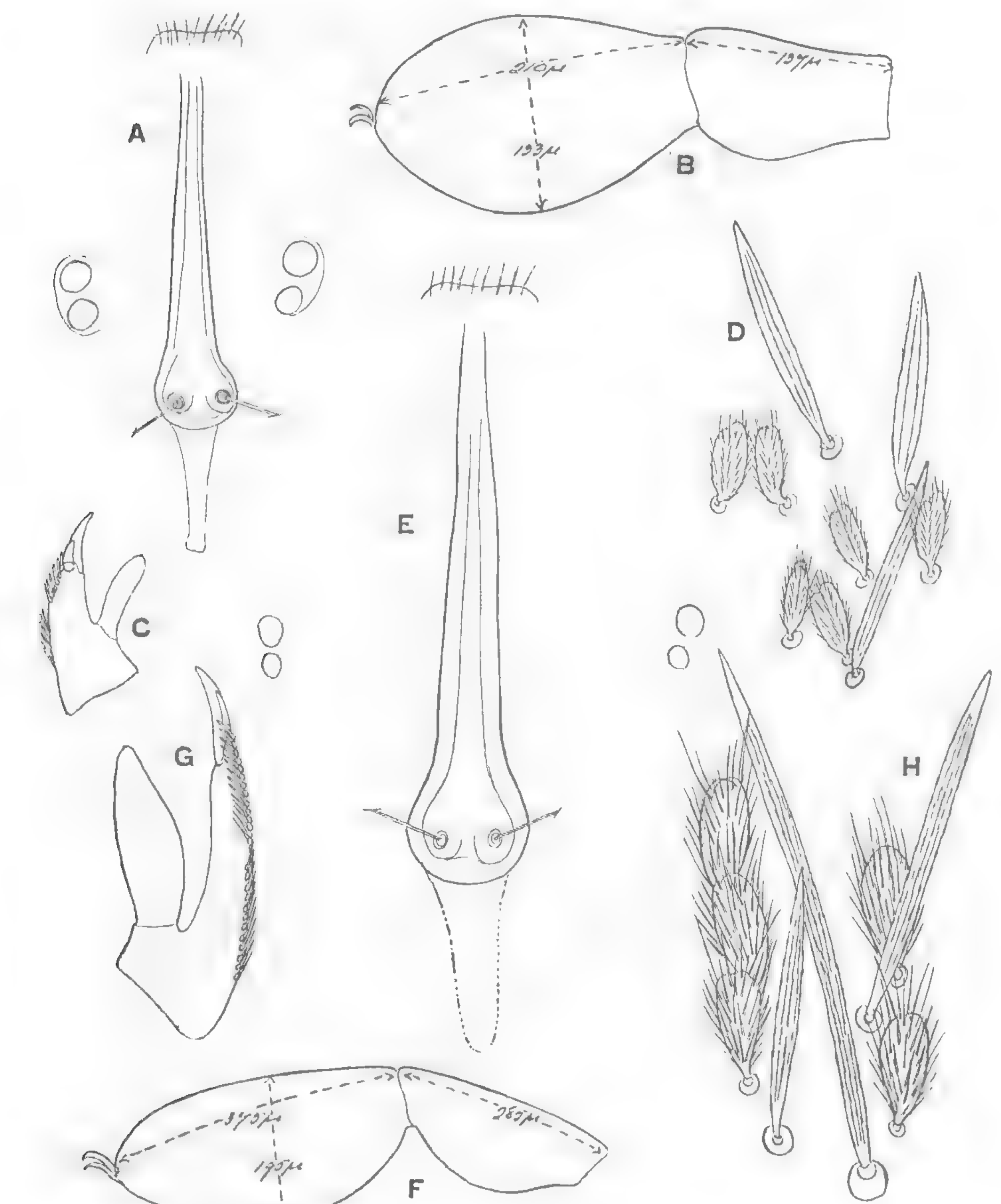

Fig. 6. A–D. *Spathulathrombium southcotti* (Wom.): A, Crista and eyes (× 200); B, front tarsus and metatarsus (× 200); C, palpal tibia and tarsus (× 200); D, dorsal setae (× 375). E–H. *Spathulathrombium maximum* sp. n. E, Crista and eyes (× 200); F, front tarsus and metatarsus (× 87); G, palpal tibia and tarsus (× 200); H, dorsal setae (× 375).

SPATHULATHROMBIUM SOUTHCOTTI (Wom., 1934).

Microtrombidium southcotti Wom., 1934. Rec. S. Aust. Mus., 5 (2), 197.
Echinothrombium southcotti (Wom., 1937). Rec. S. Aust. Mus, 6 (1), 90.

Fig. 6 A–D.

Redescription. Adult. Shape somewhat elliptical, broadest across shoulders. Colour red. Length to 1·5 mm., width to 0·825 mm. Legs all shorter than body, I 900μ, II 675μ, III 750μ, IV 900μ; tarsus I 218μ long by 108μ high, metatarsus I 135μ long. Crista linear, elongate, 338μ, with subposterior sensillary area at about ⅔ from apex, sensillae ca. 100μ long, and apparently nude, their bases 30μ apart. Mandibles with finely serrate inner edge to chelae. Palpi as in the genus, tibia without external spine, tarsus elongate but not reaching tip of claw. Eyes 2+2, ocular shields ill-defined, and slightly in advance of sensillary area. Dorsal setae of two kinds and lengths as in the genus; the shorter setae spathulate, to 26μ long by 8μ wide, slightly indented at apex and furnished with long ciliations which are slightly longer apically; longer setae spine-like, 75μ long by 6·5μ wide, tapering apically and with longitudinal rows of indistinct serrations.

Loc. A single specimen (type) from Belair, South Australia, Jan. 1943. (R.V.S.).

SPATHULATHROMBIUM MAXIMUM sp. nov.

Fig 6 H–E.

Description. Adult. Shape as in genotype. Colour red. Length to 3·0 mm., width to 2·1 mm. across the moderately pronounced shoulders. Legs not or only slightly longer than body, I 2100μ, II 1445μ, III 1500μ, IV 2500μ, tarsus I 405–480μ long by 150–180μ high, metatarsus I 300–360μ long. Crista elongate and fairly thick, 470μ long, with subposterior sensillary area at about ⅔ from apex, with paired apparently nude sensillae, ca. 200μ long and their bases 50μ apart. Eyes 2+2 well in advance of sensillary area. Chelicerae with finely serrate inner edge. Palpi as figured the distal portion of tibia very slender (cf. fig. 6 G), tarsus elongate, barely reaching tip of tibial claw. Dorsal setae as in fig. 6 H, of two kinds and sizes, the smaller ones spathulate with long ciliations, to 36μ long by 14μ wide, and slightly incised apically; longer setae spine-like, 70 to 165μ long by 6·5μ wide, with a strong apical point, and longitudinal rows of indistinct minute serrations.

Loc. Type a single specimen from Greenborough, Vic., 22 Aug., 1934 (A. Tubb); another from Mt. Wellington, Tas., Sept. 1935 (J. W. Evans).

Remarks. Very much larger than *southcotti* in which it agrees in the form but not size of the smaller setae. It differs, however, in the dimensions of the front tarsi and metatarsi.

SPATHULATHROMBIUM QUEENSLANDIAE sp. nov.

Fig. 7 A–D.

Description. Adult. Colour red. Shape as in preceding species. Length 1·6 mm., width 1·2 mm., with only moderately prominent shoulders. Legs relatively short, I 715μ, II 475μ, III 529μ, IV 765μ; tarsus I 175μ long by 108μ wide, metatarsus I 119μ long. Crista elongate and moderately thick, 260μ long with subposterior sensillary area, posterior arm evanescent, sensillae ca. 150μ long, nude, with bases 21μ apart. Eyes 2+2, apparently not on ocular shields, and only slightly in advance of sensillary area. Palpi as figured, distal portion of tibia fairly slender, tarsus elongate only reaching to base of claw. Dorsal setae of two

kinds and sizes, the smaller spathulate or battledore shaped, 32μ long by 8μ wide, with short denticles; the larger slender, slightly curved and spine-like, fairly uniform in length to 70μ and with distinct short setules or denticles.

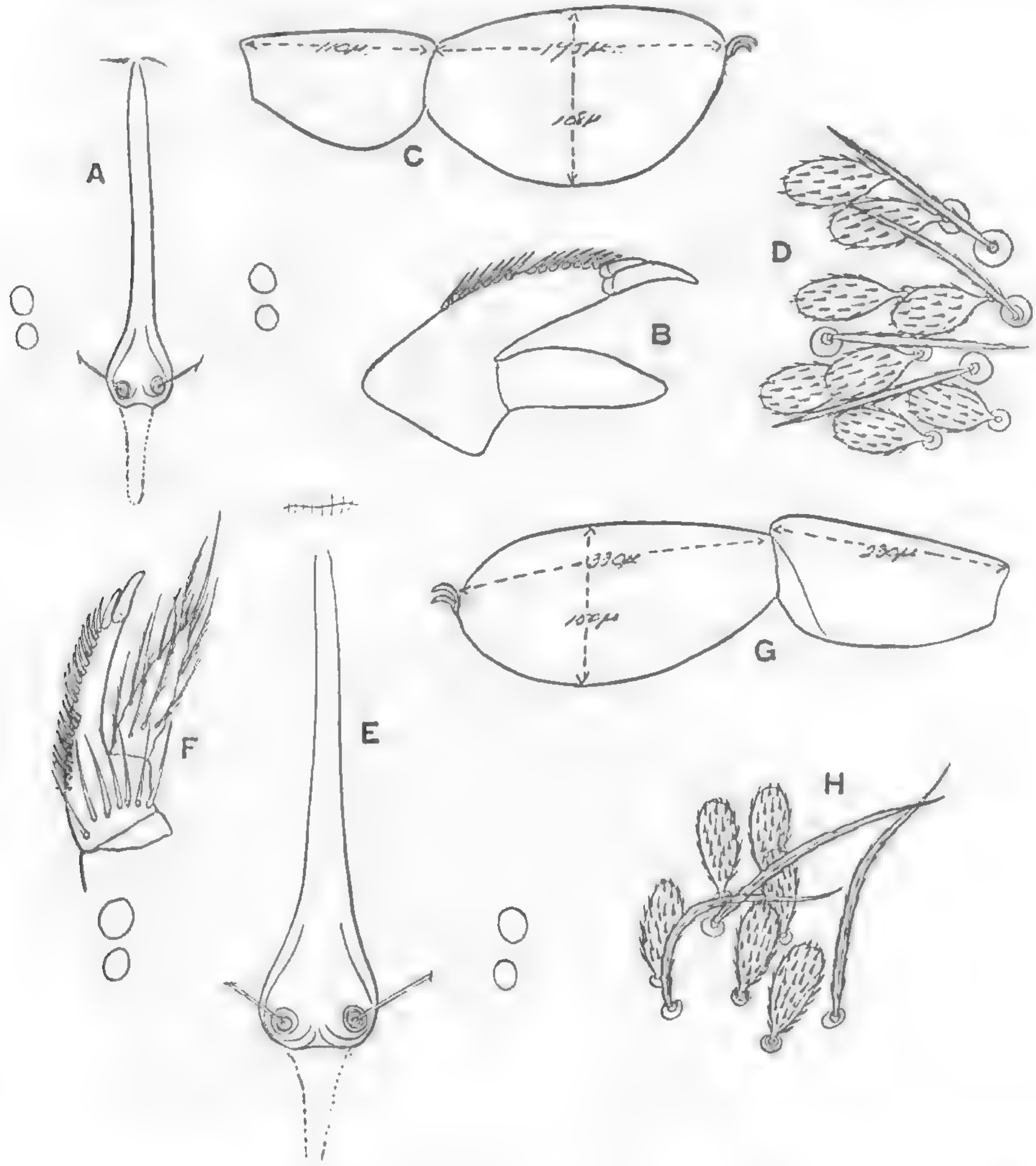

Fig. 7. A–D. *Spathulathrombium queenslandiae* sp. n. A, Crista and eyes (× 200); B, front tarsus and metatarsus (× 200); C, palpal tibia and tarsus (× 375); D, dorsal setae (× 375). E–H. *Spathulathrombium fulgidum* sp. n. E, Crista and eyes (× 200); F, front tarsus and metatarsus (× 200); G, palpal tibia and tarsus (× 200); H, dorsal setae (× 375).

Loc. A single specimen from amongst Lantana debris, Gympie, Queensland. April 27, 1940 (D.J.W.S.).

Remarks. This species is very close to the next *S. fulgidum* sp. n. in the form and size of the shorter dorsal setae but differs in the dimensions of the front tarsi, straighter and relatively more uniform longer dorsal setae, the much less slender palpi, and in size.

SPATHULATHROMBIUM FULGIDUM sp. nov.

Fig. 7 E–H.

Description. Adult. Colour red. Shape as in other species but shoulders not very pronounced. Length 1·575 mm., width 0·9 mm. Legs shorter than body, I 1445μ, II 1050μ, III 975μ, IV 1350μ, tarsus I 330μ long by 150μ high, metatarsus I 230μ long. Crista linear, 420μ long, with subposterior sensillary area, but crista behind sensillary area evanescent, with paired filamentous, apparently nude sensillae, their bases 25μ apart. Mandibular chelae with finely serrated inner edge. Palpi as figured, distal part of tibia slender and long, tarsus rather conical only reaching to base of claw. Eyes 2+2, apparently not on ocular shields. Dorsal setae of two kinds and lengths; smaller to 32μ long, spathulate or battledore shaped with short strong denticles; longer setae spine-like, strongly curved, more slender than in *queenslandiae*, 70–90μ long, with indistinct short serrations.

Loc. A single specimen from Robe, South Australia, 13th Oct., 1943 (H.W.).

Remarks. Close to *queenslandiae* but differing as discussed under that species.

SPATHULATHROMBIUM MYLORIENSE sp. nov.

Fig. 8 A–D.

Description. Adult. Colour red. Shape as in other species, shoulders not prominent. Length 2·55 mm., width 1·35 mm. Legs not longer than body, I 1275μ, II 900μ, III 930μ, IV 1200μ, tarsus I 285μ long by 93μ high, metatarsus I 185μ long. Crista elongate, 375μ long and fairly thick, sensillary area subposterior, but appearing posterior, the crista behind the area being evanescent, with paired nude filamentous sensillae, their bases 21μ apart. Eyes 2+2, about on a level with sensillary area and apparently not on ocular shields. Chelae with finely serrated inner edge. Palpi as figured, distal portion of tibia slender, tarsus elongate, conical, reaching just beyond base of claw. Dorsal setae of two kinds and lengths, the smaller spathulate but rather elongate with almost parallel sides, 56μ long by 11μ wide, and furnished with strong short denticles; longer setae spine-like (cf. fig. 8 D) with ribs of indistinct serrations, to 120μ long by 6·5μ wide.

Loc. A single specimen from Mylor, South Australia, 14 Sept., 1935 (H.W.).

Remarks. Allied to *queenslandiae* and *fulgidum* but distinct in the form of the dorsal setae and in the dimensions of the front tarsi and metatarsi.

KEY TO THE SPECIES OF *Spathulathrombium*.

1. Dorsal microsetae with long ciliations .. .. 2.
   Dorsal microsetae with short denticles .. .. 3.
2. Small species to 1·5 mm. long. Microsetae 26μ by 8μ, macrosetae spine-like, to 75μ long with indistinct serrations, almost straight. T_1 210μ by 105μ, M_1 135μ. *southcotti* (Wom.).
   Larger species to 3·0 mm. long. Microsetae 36μ by 14μ, macrosetae as above, 70–165μ long, only slightly curved. T_1 405–480μ by 150–180μ, M_1 300–360μ. S.B. 47–50μ *maximum* sp. nov.
3. Larger species to 2·5 mm. long. Microsetae to 56μ by 11μ, macrosetae to 120μ long by 6·5μ wide, with only indistinct serrations. T_1 285μ by 93μ, M_1 185μ. S.B. 21μ. *myloriense* sp. nov.
   Smaller species to ca. 1·7 mm. long. Microsetae 32μ long, with curved sides. Macrosetae with distinct denticles .. .. 4.
4. Macrosetae almost or quite straight, uniform to 70μ in length. T_1 162μ by 95μ, M_1 108μ. SB 21μ .. .. *queenslandiae* sp. nov.
   Macrosetae strongly curved, not stiff, from 70–90μ long. T_1 330μ by 150μ, M_1 236μ. SB 25μ *fulgidum* sp. nov.

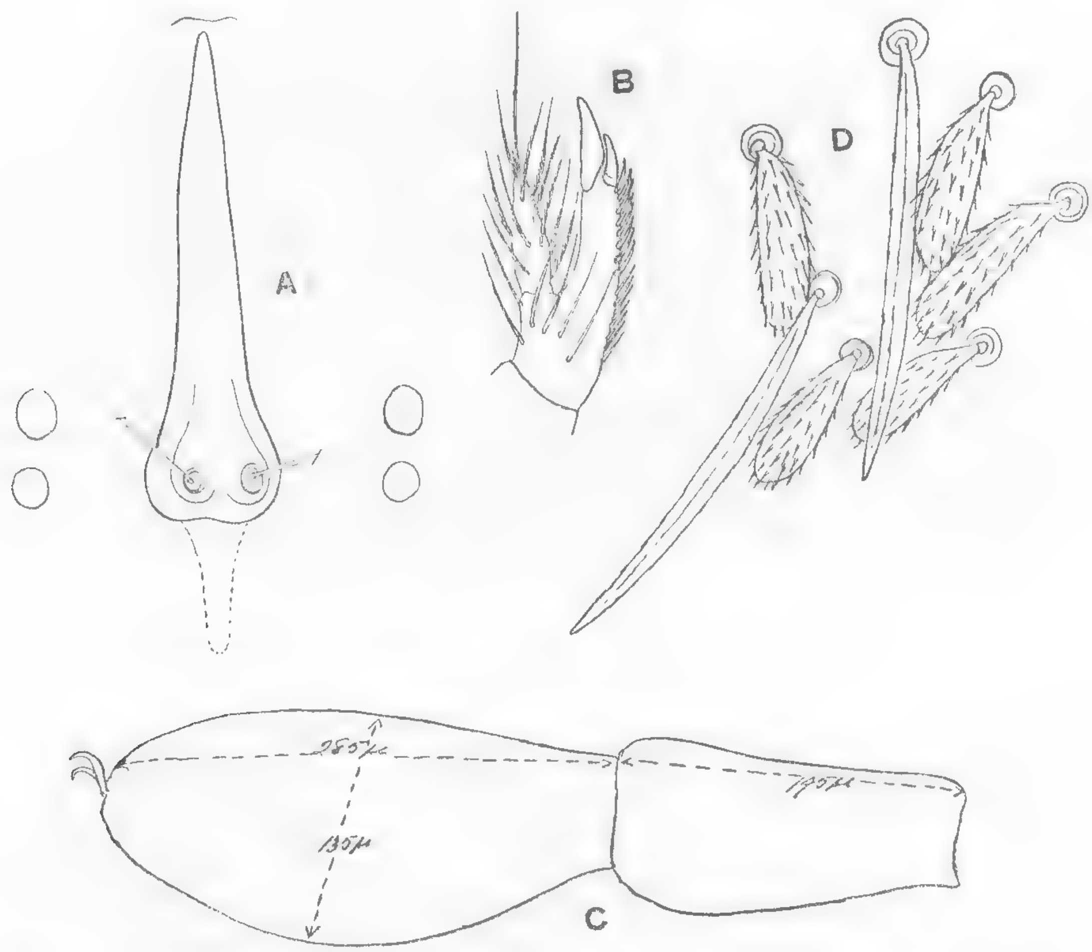

Fig. 8. *Spathulathrombium myloriense* sp. n. A, Crista and eyes (× 200); B, palpal tibia and tarsus (× 200); C, front tarsus and metatarsus (× 200); D, dorsal setae (× 375).

Genus MICROTROMBIDIUM Haller, 1882 s.str.

Milbenf. Wurtemb., 1882.

Genotype. *M. pusillum* Hermann, 1804.

Manriquia Boshell and Kerr, 1942 (in part) Rev. Acad. Columbiana Ci. Ex., 5, 110–127.

Microtrombidium Boshell and Kerr, 1942 *ibid.* (in part).

As in the subfamily but restricted to those in which the legs are not, or not much longer than the body and in which the dorsal setae, even if of two different lengths, are pennate or as slender rods with long ciliations. Palpal tibia with or without accessory claw, and without or with one or two external spines.

The members of this genus are very difficult to separate, and the specific characters lie principally in the dimensions of the front tarsi and metatarsi and in the lengths and structure of the dorsal setae. In reviewing this genus, all my old material has been restudied more carefully and, with more material before me, it is evident that several species are synonymous and are here sunk.

The three species *barringunense* Hirst, *retentus* Banks and *westraliense* Wom. are herewith removed from *Microtrombidium* and will be later allocated to their proper position.

MICROTROMBIDIUM ZELANDICUM Wom., 1936.

Fig. 9 A–D.

Microtrombidium zelandicum Womersley, 1936, J. Linn. Soc. London, Zool. 40, 107, fig. 1 a–e.

Redescription. Colour (in spirit) white, in life probably red. Shape roughly elliptical, without pronounced shoulders. Length 1·81 mm., width 0·9 mm. Legs not much longer than body, I 2100μ, II 1010μ, III 940μ, IV 1810μ, tarsus I elongate, 480μ long by 145μ high, metatarsus I 320μ long. Crista linear, 438μ long, with

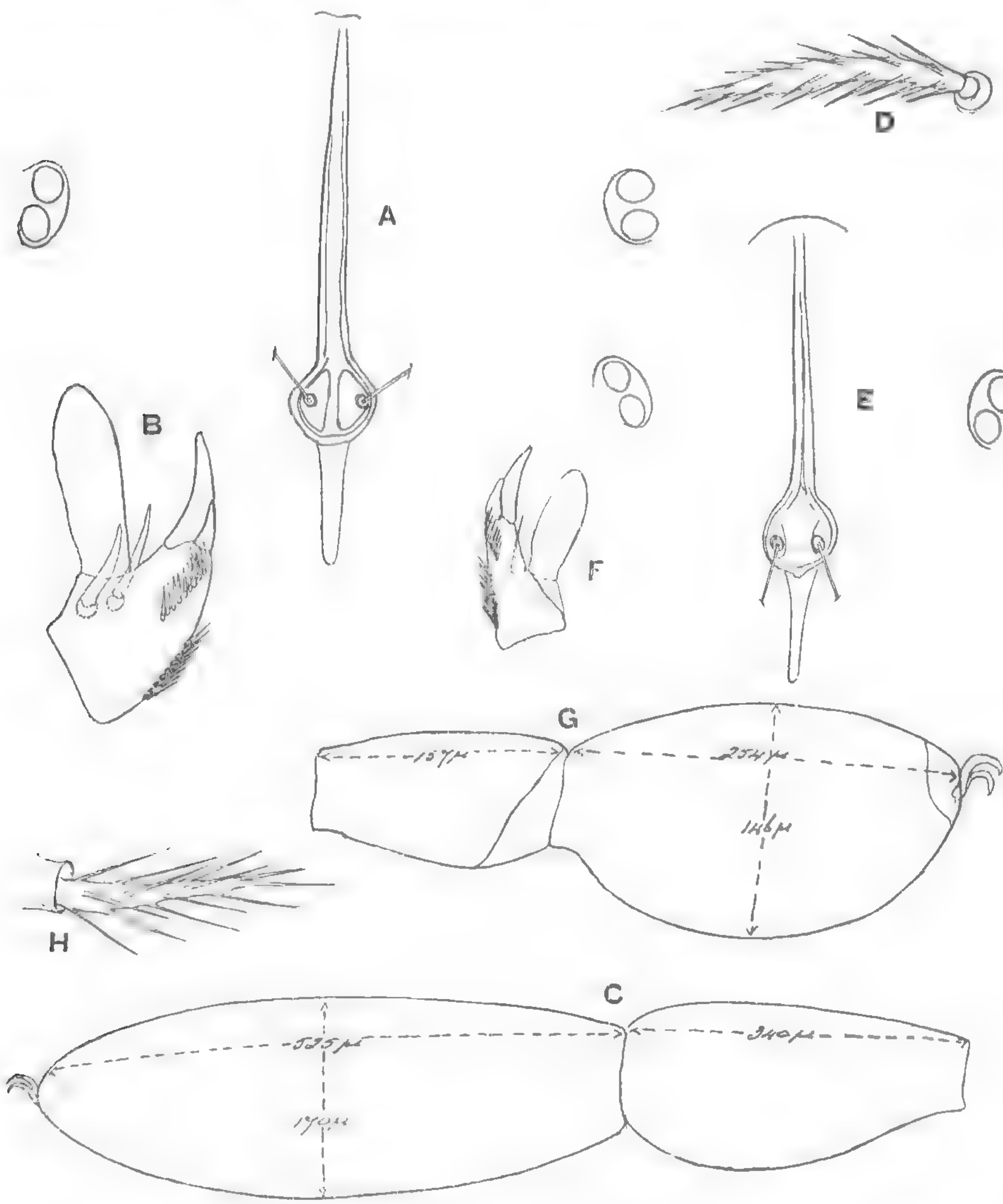

Fig. 9. A–D. *Microtrombidium zelandicum* Wom. A, Crista and eyes (× 200); B, palpal tibia and tarsus (× 200); C, front tarsus and metatarsus (× 125); D, dorsal setae (× 860). E–H. *Microtrombidium maculatum* Wom. E, Crista and eyes (× 200); F, palpal tibia and tarsus (× 200); G, front tarsus and metatarsus (× 200); H, dorsal setae (× 860).

subposterior area at about ⅔ from apex, sensillae long and filamentous and their bases 36μ apart. Eyes 2+2, well in advance of sensillary area, and on distinct ocular shields. Palpi as figured with strong tibial claw and accessory claw, two pectines and on external side with two strong spines arising from behind base of tarsus; tarsus elongate, slightly clavate and overreaching tip of claw. Dorsal setae uniform in length, 30μ, tapering and with long ciliations (cf. fig. 9D).

Loc. Pukekarura Creek, Niger Bay, Manurewa, New Zealand, 31st Dec. 1932 (E.D.P.). One specimen.

Remarks. Distinguished from other species as in the key.

Microtrombidium maculatum Wom., 1942.

Rec. S. Aust. Mus., 7 (2), 175; fig 6 A–E.

Fig. 9 E–H.

Redescription. Adult. Colour in life dark red except in the area of the crista and eyes and on fifteen round spots on the dorsum where it is white. Shape elongate oval, broadest across shoulders. Length 1·04 mm., width 0·720 mm. Legs relatively short, I 1040μ, II 608μ, III 480μ, IV 720μ, tarsus I about twice as long as high, 255μ by 125μ, metatarsus I 150μ long. Crista linear, 270μ, with subposterior sensillary area at ⅔ from apex, furnished with paired filamentous sensillae, 108μ long and their bases 30μ apart. Eyes 2+2, on distinct ocular shields and well in advance of sensillary area. Palpi as figured, tibia with strong apical claw, smaller accessory claw, two pectines and one slender external spine arising from near base of tarsus; tarsus elongate, hardly clavate and not reaching tip of claw. Dorsal setae uniform, fairly thick stemmed, 25μ, and with long setules (cf. fig. 8H).

Loc. A single specimen from a rotting tree-fern log, Belgrave, Vic., Nov., 1941 (O.W.T.).

Remarks. The only Australian species yet known with white maculations.

Microtrombidium karriensis Wom., 1934.

Rec. S. Aust. Mus., 1934, 5 (2), 191, fig. 28–30.

M. (*M.*) *tasmanicum* Womersley, 1937, *ibid,* 6 (1), 88, fig. 1 k–m.

Fig. 10 A-E.

Redescription. Adult. Colour in life red. Body more or less elliptical with rounded not prominent shoulders, narrowing in region of coxae IV and rounded posteriorly. Size variable, length to 1·95 mm., width to 1·20 mm. (in type 1·20 mm. and 0·78 mm.), legs not longer than body, in type I 1080μ, II 730μ, III 700μ, IV 1050μ, tarsus I as figured, elliptical but greatest height near to base, and there roundly angulate, length (13 specimens) 346μ to 164μ, height 182μ to 101μ, averaging 250μ by 134μ, the ratio of height to length averaging 1·0:1·9; metatarsus I 200μ to 86μ long (average 134μ). Crista linear, type 256μ long, with subposterior sensillary area, at about ⅘ from apex, with paired apparently nude filamentous sensillae ca. 120μ long, and their bases 32μ apart. Eyes 2+2, on ocular shields well in front of sensillary area. Mandibles with stout chelae with serrate inner edge. Palpi as figured, tibia with external spine arising from near base of tarsus and reaching beyond middle of claw; tarsus elongate, slender, slightly conical, and reaching to middle of claw. Dorsal setae dense and uniform, thick stemmed, 30μ long (cf. fig. 10E) with long ciliations. On the legs the setae are similar but slightly longer.

Loc. Apparently a common and widely distributed species. Type from Denmark, Western Australia, June 6, 1933 (H.W.).

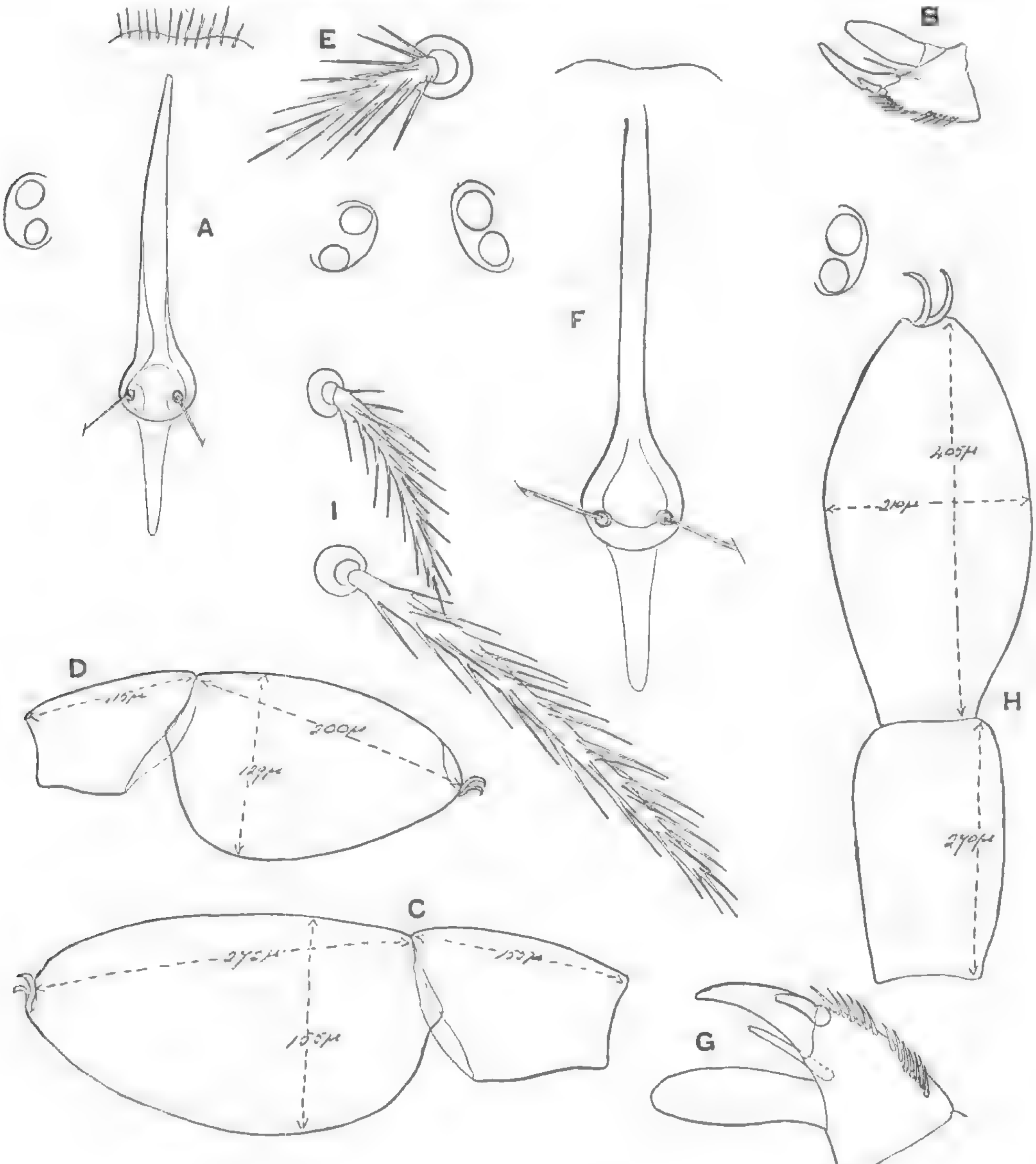

Fig. 10. A–E. *Microtrombidium karriensis* Wom. A, Crista and eyes (× 200); B, palpal tibia and tarsus (× 200); C, front tarsus and metatarsus ♀ (× 200); D, same ♂ (× 200); E, dorsal seta (× 860). F–I. *Microtrombidium hirsutum* sp. n. F, Crista and eyes (× 200); G, palpal tibia and tarsus (× 200); H, front tarsus and metatarsus (× 200); I, dorsal setae (× 860).

Other specimens: South Australia: Belair, 1935–1938, from May to July, in moss; Blewet's Springs, near Clarendon, June 1944; Tasmania: Mt. Wellington, Sept. 1935, Dec. 1937.

Remarks. This species is closely related to *M. pusillum* (Hermann, 1804) Berl., 1912, from Europe, of which Berlese (1912) has described the varieties *columbianum* from North America and *balzani* from South America. Our spe-

cies differs from *pusillum* in the presence of the external spine on the palpal tibia. In having only one such spine it also agrees with *americanum* (Leon.) from Chile, and with *jabanicum* Berl. from Java. It differs from *americanum*, however, in the form and dimensions of the front tarsi and metatarsi, but agrees in these characters with *pusillum* and *jabanicum*. In the last species the external spine on the palpal tibia is short and arises close to the base of the claw (cf. Berl., 1912); in *karriensis* it is long and more slender and arises from near the articulation of the tarsus. The dorsal setae are about as long as, but thicker stemmed than, in *pusillum*, and shorter than in *americanum*.

The species is somewhat variable in size and also in the dimensions, but not the relative proportions of the front tarsi and metatarsi.

In the following table are given the measurements in microns, of thirteen specimens including the type.

			Tarsus I.			Metatarsus I.		Crista.		
Loc.	Length.	Width.	Lgh.	Ht.	L/H.	Lgh.	Lt/Lm.	Lgh.	SB.	DS.
Denmark, W.A.	1,200	780	272	155	1·78	155	1·78	330	32	30
Belair, S.A.	1,800	1,050	346	153	2·26	200	1·73	405	29	30
" "	1,200	900	292	133	2·19	150	1·95	346	29	30
" "	1,875	1,150	292	130	2·25	140	2·08	—	—	29
" "	1,950	1,200	310	182	1·70	182	1·70	405	32	30
" "	1,500	975	292	126	2·31	130	2·25	328	25	29
" "	1,125	720	164	86	1·91	86	1·91	236	25	29
" "	1,125	720	210	112	1·87	115	1·83	310	25	29
" "	1,170	750	218	115	1·90	119	1·83	325	32	29
" "	1,425	950	235	122	2·10	126	1·86	328	29	30
" "	1,200	770	189	100	1·89	101	1·89	255	25	29
" "	1,350	900	218	122	1·78	126	1·73	—	—	29
" "	1,250	810	200	101	2·00	108	1·85	272	29	30

A study of the above measurements suggests that the specimens 2, 4 and 5 in which the values are much higher than for the others may be females, the rest males. All the thirteen were fully adult as shown by the three pairs of genital discs.

A single specimen from Long Gully, South Australia, 11th June, 1938, measured 1500μ long with tarsus I 195μ by 100μ, and metatarsus 105μ, but had the dorsal setae 40–43μ long. It may perhaps be considered a variety.

The two specimens described as *tasmanicum* Wom., 1937 (*loc. cit.*) as well as two others from Mt. Wellington, Tas., Dec., 1937, agree with *karriensis* except that in the first two, the ratio of length of tarsus I to metatarsus I is 1·0:1·40 and 1·0:1·32.

Microtrombidium hirsutum sp. nov.

Fig. 10 F–I.

Description. Adult. Length 2·1 mm., width 1·5 mm. Colour in life red. Shape as in other species. Legs I 1875μ, II 1275μ, III 975μ, IV 1425μ; front tarsus 405μ long by 210μ high, metatarsus 270μ long. Crista elongate, 460μ long, with subposterior sensillary area, paired filamentous sensillae with their bases 25μ apart. Eyes 2+2, on distinct ocular shields. Palpi stout, tibia with stout apical claw, smaller accessory claw, two pectines, and a strong external spine. Dorsal setae slender with only moderately long setules (cf. fig. 10 I) varying in size from 40μ to 75μ, but with no sharp demarcation into two distinct sizes.

Loc. A single specimen from Morialta, South Australia, 2nd Sept., 1934. (H.W.).

Remarks. Separated as in the key to species on the dorsal clothing and the dimensions of the front tarsi and metatarsi.

MICROTROMBIDIUM WELLINGTONENSE sp. nov.

Fig. 11 A–C.

Description. Nymph. Colour in life red. Shape as in other species of the genus. Length 1·725 mm.; width 1·05 mm. Legs all shorter than body, I 930μ, II 600μ, III 600μ, IV 930μ; tarsus I 282μ long by 133μ high, metatarsus I 160μ long.

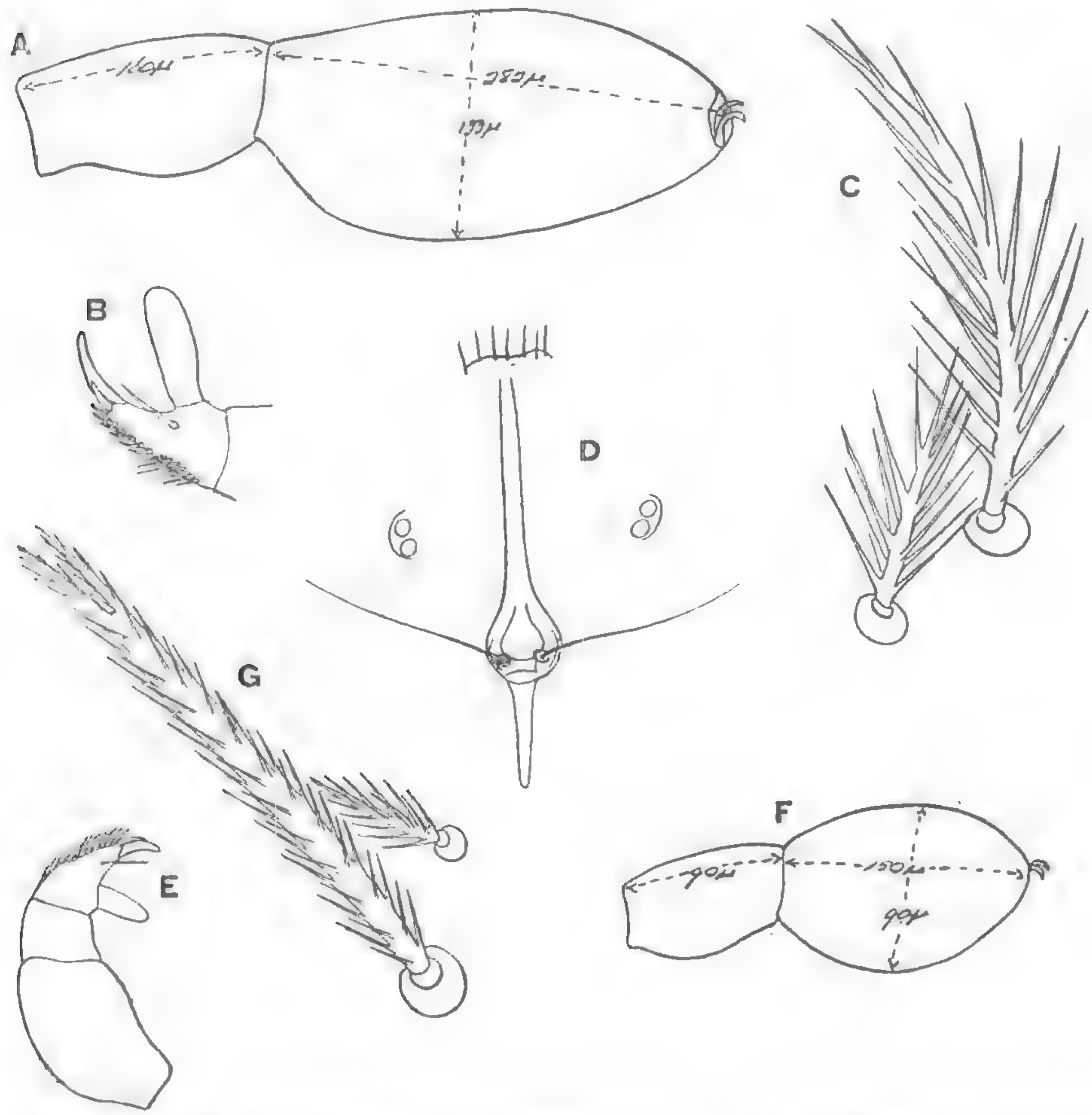

Fig. 11. A–C. *Microtrombidium wellingtonense* sp. n. A, Front tarsus and metatarsus (× 200); B, palpal tibia and tarsus (× 200); C, dorsal setae (× 860). D–G. *Microtrombidium furcipile* (Canest). D, Crista and eyes (× 200); E, palp (× 200); F, front tarsus and metatarsus (× 200); G, dorsal setae (× 860).

Crista and eyes not available for description owing to damage. Palp stout, tibia with the usual strong claw and accessory claw and two pectines and with one slender externl spine arising near articulation of tarsus (cf. fig. 11 B); tarsus elongate, over-reaching tip of claw. Chelicerae with finely serrate inner edge. Dorsal setae slender with very long setules (cf. fig. 11 C), length varying from 40μ to 80μ posteriorly but without any clear demarcation into two sizes.

Loc. One specimen from Mt. Wellington, Tas., Dec. 9th, 1937 (J.W.E.).

MICROTROMBIDIUM PAPUANUM sp. nov.

Fig. 12 A–D.

Description. Adult. Colour in life red. Shape as in other species of the genus. Length 1·05 mm., width 0·6 mm. Legs shorter than the body, I 855μ, II 540μ, III 540μ, IV 750μ, tarsus I broadly elliptical with ventrobasal shoulder, 151μ long by 100μ high, metatarsus I 90μ long. Crista linear, 218μ long, with subposterior sensillary area with paired filamentous sensillae, their bases 20μ apart. Eyes 2+2, large, on well defined ocular shields. Mandibles with chelae finely serrated on inner edge. Palpi stout, tibia normal, with slender external spine; tarsus elongate, reaching to about tip of claw. Dorsal setae of two sizes as in fig. 12 D, more or less fusiform, with only moderately long setules, shorter setae 16μ long, longer setae to 32μ long.

Loc. Two specimens in soil, Dobodura area, New Guinea, about July, 1944 (G. M. Kohls). Four other specimens from Goodenough Is., Aug., 1944 (D.C.S.) in damp soil in typhus area, do not differ in the dorsal setae, although the dimensions of the front tarsi and metatarsi are somewhat variable, as given in the following key to species.

MICROTROMBIDIUM MYLORIENSE sp. nov.

Fig. 12 E–H.

Description. Adult. Colour in life red. Shape as in other species. Length to 2·5 mm., width to 1·8 mm. Legs shorter than body, I 1500μ, II 1050μ, III 1000μ, IV 1445μ, tarsus I more or less parallel sided and elongate, 405μ long by 120μ high, metatarsus 240μ long. Crista linear, 390μ long, with subposterior sensillary area with paired filamentous sensillae with their bases 40μ apart (cf. fig. 12 E). Eyes 2+2, fairly large and on well chitinized ocular shields. Mandibles with chelae finely serrate on inner edge. Palpi stout, tibia normal with stout accessory claw, two pectines and a fairly stout pointed external spine (cf. fig. 12 F); tarsus elongate, only barely reaching tip of claw. Dorsal setae of two sizes, the larger to 55μ long, stout, thick, only slightly pointed at apex, the smaller to 21μ long, relatively slightly more slender than longer setae, both sizes with fairly long outstanding setules (cf. fig. 12 H).

Loc. The type and 1 paratype, Mylor, South Australia, Oct., 1935; two other specimens Mylor, 14th Sept., 1935, and Belair, S. Aust., 26th Sept., 1927.

MICROTROMBIDIUM cf. FURCIPILE (Canestrini, 1897).

Ottonia furcipilis G. Canest., 1897, Ved. Atti. Soc. Veneto. Trentina, 2, 3; 2, 398; Termes. Fuzet., 21, 483.

Microtrombidium furcipile, Berl., 1912, Redia, 8, 161.

Microtrombidium hystricinum, Womersley, 1924. Rec. S. Aust. Mus., 7 (2), 177 (in part).

Fig. 11 D–G.

This species was originally described by Canestrini from Erima, New Guinea. I have recently received specimens of what I take to be Canestrini's species from Dobodura area, New Guinea and collected in soil by Maj. G. M. Kohls. Further I now find that the specimens from Malanda, Queensland, previously recorded by me as *hystricinum* (*loc. cit.*) are co-specific with those received from New Guinea.

Canestrini speaks of some of the longer dorsal setae as being "biforcate" and in the specimens now referred to his species some of these seta, although

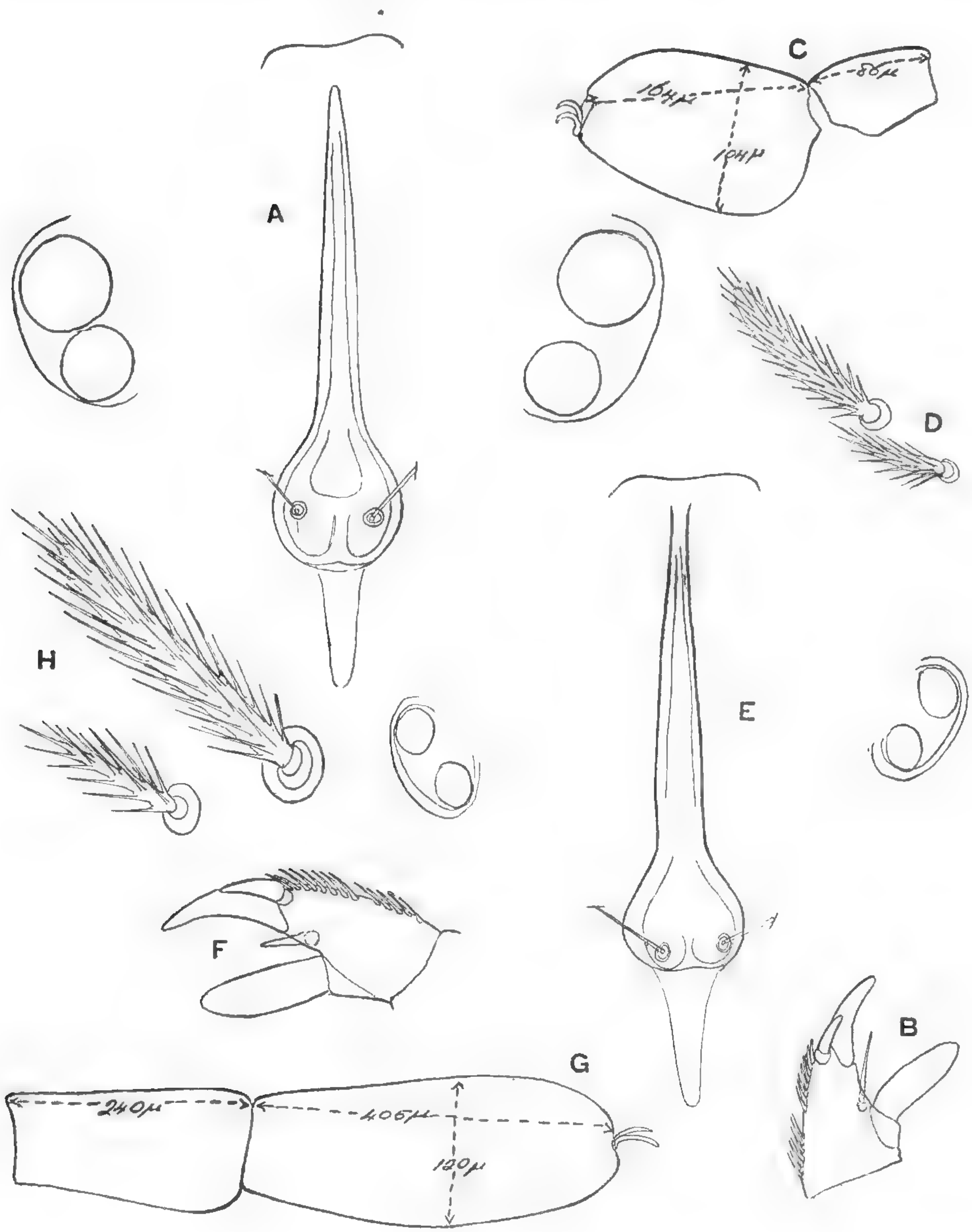

Fig. 12. A–D. *Microtrombidium papuanum* sp. n. A, Crista and eyes (× 375); B, palpal tibia and tarsus (× 375): C, front tarsus and metatarsus (× 200); D, dorsal setae (× 860). E–H. *Microtrombidium myloriense* sp. n. E, Crista and eyes (× 200); F, palpal tibia and tarsus (× 375); G, front tarsus and metatarsus (× 125); H, dorsal setae (× 860).

not strictly bifurcate, are bifid or split for a short distance at the tip, but the prongs of the fork are not spread out.

The description given by Canestrini for many species of Trombidiidae are, however so brief and inadequate and without figures that one cannot be quite sure of what he meant. *Furcipile* is the only species which he described as having furcate setae, and as some of my specimens are from New Guinea, they are referred to his species, although somewhat tentatively

Description. Adult. Colour red, shape ovoid, shoulders not very pronounced. Length 0·9 mm., width 0·55 mm. Legs not longer than body, I 740μ, II 420μ, III 400μ, IV 550μ; tarsus I 150μ by 90μ high, metatarsus I 90μ long. Eyes 2+2, on ocular shields in advance of sensillary area. Crista as figured, 220μ long with subposterior sensillary area at about $\frac{2}{3}$ from apex, sensillae 146μ long and apparently nude, with bases 21μ apart. Palpi as figured, tibia with one tapering external spine, tarsus rather short and not reaching tip of tibial claw. Dorsal setae of two forms and sizes, the smaller tapering, 16–20μ long, pennate with long ciliations, the larger 60–75μ long rod-like, with moderate long setules and split at the apex for approximately 7μ.

Loc. Five specimens from soil collected by Maj. G. M. Kohls, April, 1944, Dobodura area of New Guinea; also two specimens from English Jungle, Malanda, Queensland, August, 1935 (previously recorded (1937) as *hystricinum* Canest.).

Remarks. This species was apparently described without any figures and it is therefore rather uncertain what Canestrini means by "l'estremita distale e qui biforcate." As however, his *furcipile* is the only species with forked setae previously recorded from New Guinea the material before me is referred to it.

MICROTROMBIDIUM AEQUALIS (Banks, 1916).

Trombidium aequalis Bks., 1916, Trans. Roy. Soc. S. Aust. 40, 226, pl. xxiii, Fig. 1.
Microtrombidium aequalis Wom., 1934. Rec. S. Aust. Mus., 5 (2), 191.

Fig. 13 A–G.

A female specimen from Greenbushes. Western Australia, was referred to this species (1934) the type of which is now not in the South Australian Museum. This female is now described, as is also a smaller specimen, probably a male, from New Guinea.

Description of female. In life red. Shape cordate as in other species of the genus. Length 1·2 mm., width 0·75 mm. Legs not longer than the body, I. stronger and stouter than the others, I 1150μ long, II 675μ, III 750μ, IV 1275μ, tarsus I elliptical ovate, about twice as long as high, 300μ by 157μ, metatarsus 190μ long, claws slightly unequal. Crista linear, 318μ long with subposterior sensillary area, with sensillae bases 21μ apart, sensillae filamentous. Eyes 2+2, sessile, on distinct ocular shields. Chelicerae finely serrate on inner edge. Palpi stout (cf. fig. 13 B), tibia with strong claw and accessory claw, two pectines and a slender external spine; tarsus elongate, only slightly clavate, not reaching tip of claw. Dorsal setae relatively sparse, uniform, more or less pennate, with long setules, to 16μ long.

Description of male? Similar to female. Length 1·05 mm., width 0·75 mm. Legs I 930μ, II 630μ, III 630μ, IV 630μ, tarsus I as in female, 228μ long by 118μ high. metatarsus 145μ, claws slightly unequal. Crista 310μ long, the portion posterior of the sensillary area evanescent with only the more chitinous tip evident, sensillae bases 21μ apart. Eyes, chelicerae and palpi as in female. Dorsal setae also as in adult but slightly more sparse.

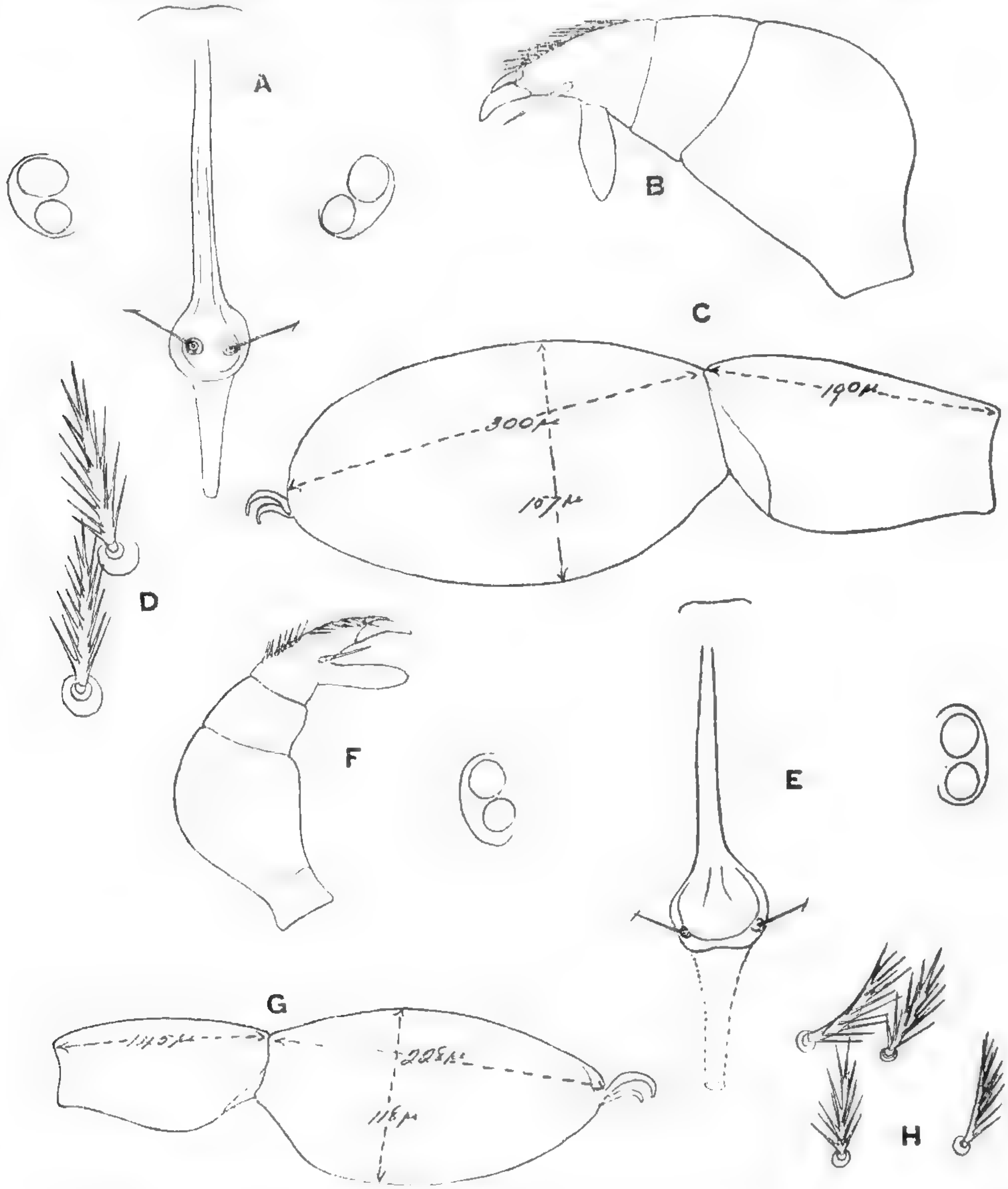

Fig. 13. *Microtrombidium aequalis* (Banks). A–D. ♀. A, Crista and eyes (× 200); B, palp (× 200); C, front tarsus and metatarsus (× 200); D, dorsal setae (× 860). E–H. ♂?. E, Crista and eyes (× 200); F, palp (× 200); G, front tarsus and metatarsus (× 200); H, dorsal setae (× 860).

Loc. Adult female from Greenbushes, Western Australia, 28th Aug., 1931 (H.W.). ? Male from soil, Dobodura area, New Guinea, 1944 (G. M. Kohls).

Remarks. In the nature of the dorsal setae and of the palpi and crista as well as the proportions of length and height of tarsi I and the ratio of length of tarsi I to metatarsi I there seems little doubt but that the above specimens are of the same species and although Banks's figures and descriptions are inadequate yet it appears reasonable to refer them to his species.

MICROTROMBIDIUM AFFINE Hirst, 1928.

Proc. Zool. Soc. London. 1928. 1026. text. fig. 3 D.

Fig. 14 A–D.

Redescription of type. Colour in life probably red. Shape cordate as in other species of the genus. Length 1·16 mm., width 0·81 mm. Legs I 1040μ, II 825μ, III 750μ, IV 1125μ, tarsus I 292μ long by 129μ high, highest in the middle, T_l/T_w = 2·26, metatarsus 230μ, T_1/M_1 = 1·26. Eyes 2+2, sessile. Crista linear, 345μ long, with subposterior sensillary area, SB 25μ apart. Sensillae filamentous. Palpi stout with strong apical and smaller accessory claw, two pectines but no external spine. Chelicerae finely serrate on inner margin. Dorsal setae uniform in length to 40μ, with strong, fairly long setules.

Loc. Besides the type, in the S. Aust. Mus. collected by J. S. Clark, Swan River, Western Australia, I refer another specimen from Adelaide, 1933 (H.W.), to this species.

MICROTROMBIDIUM NEWMANI Wom., 1934.

M. (*Enemothrombium*) *newmani* Womersley, 1934. Rec. S. Aust. Mus., 5 (2), 194. Fig. 40–42.

Fig. 14 E–H.

Redescription of type. Colour in life red. Shape cordate as in other species of the genus. Length 0·975 mm., width 0·62 mm. Legs I 825μ, II 570μ, III 525μ, IV 825μ, tarsus I 235μ long by 140μ high, T_l/T_w = 1·67, metatarsus I 126μ long, T_1/M_1 = 1·86. Eyes 2+2, sessile, on distinct ocular shields. Crista linear, 252μ long, with subposterior sensillary area and SB 25μ apart, sensillae filamentous. Chelicerae finely serrated on inner edge. Palpi stout, tibia with strong apical and stout accessory claws, two pectines, but no external spine. Dorsal setae mainly short, somewhat curved and tapering to 24μ long, with curved setules, but rather sparsely interspersed with long clavate or bushy setae, to 80μ long, furnished with only moderately long setules.

Loc. Type from Bedforddale, Western Australia, 29th Nov., 1931 (L.W.N.), and another specimen from Mandurah, Western Australia, 30th May, 1931 (H.W.).

MICROTROMBIDIUM ADELAIDICUM Wom., 1934.

M. (*Enemothrombium*) *adelaidicum* Womersley, 1934. Rec. S. Aust. Mus., 5 (2), 194, fig. 38–39.

M. (*Microtrombidium*) *adelaidicum* Womersley, 1937. Rec. S. Aust. Mus., 6 (1), 88.

M. (*Microtrombidium*) *tubbi* Womersley, 1942. Rec. S. Aust. Mus., 7 (2), 176. Fig. 7 A–C.

Fig. 15 A–D.

Redescription of type. Colour in life red. Shape cordate as in other species of the genus. Length 0·975 mm., width 0·6 mm. Legs I 720μ, II 510μ, III 510μ, IV 825μ, tarsus I broadly oval, widest at about the middle, 198μ long by 118μ high, T_l/T_w = 1·68, metatarsus 112μ long, T_1/M_1 = 1·77. Crista linear, 234μ long, with subposterior sensillary area, with SB 30μ apart, sensillae filamentous. Eyes 2+2, sessile, on distinct ocular shields. Chelicerae with finely serrate inner margin. Palpi stout, tibia with strong terminal and small accessory claw, two pectines and a slender pointed external spine. Dorsal

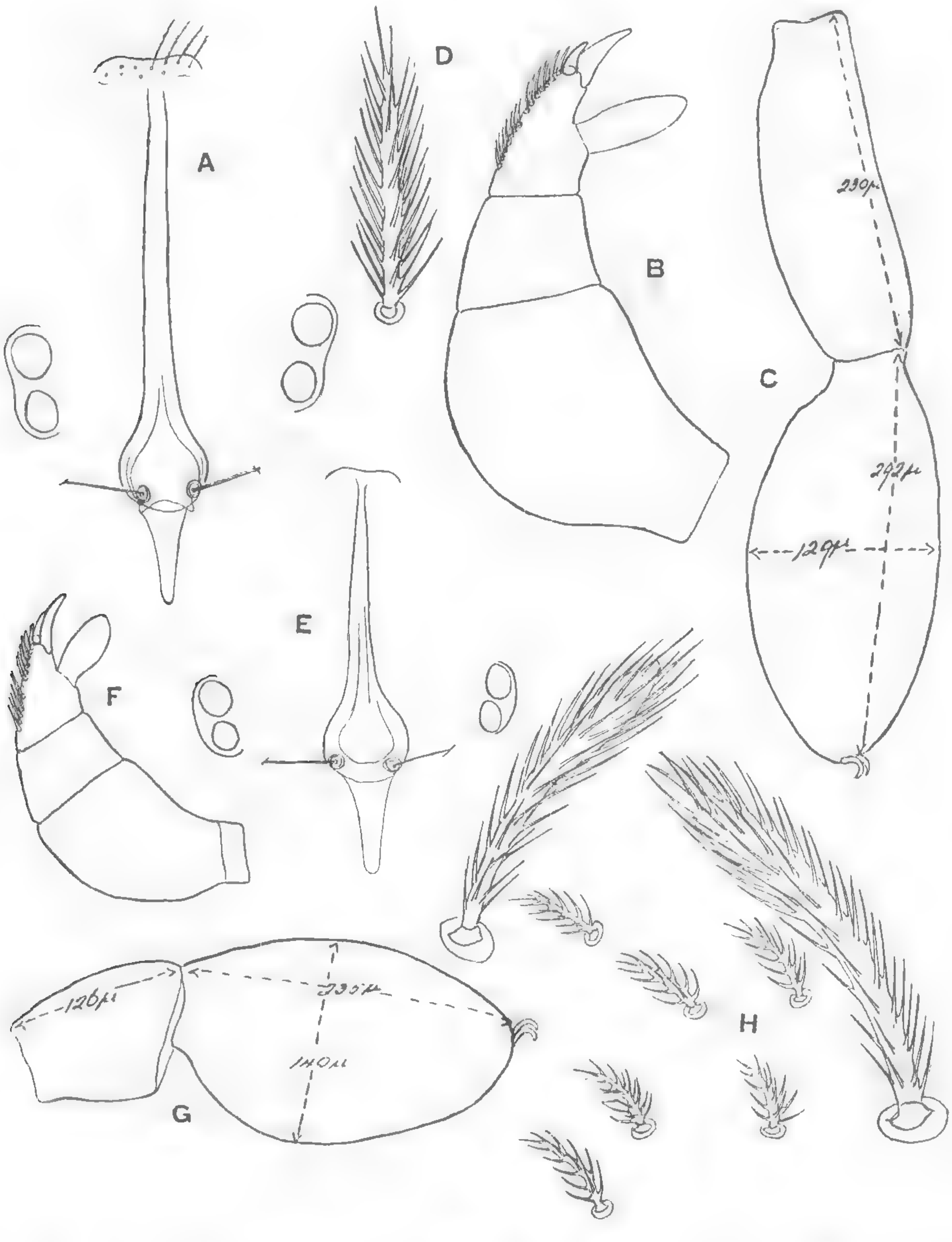

Fig. 14. A–D. *Microtrombidium affine* Hirst. A, Crista and eyes (× 200); B, palp (× 200); C, front tarsus and metatarsus (× 200); D, dorsal seta (× 860). E–H. *Microtrombidium newmani* Wom. E, Crista and eyes (× 200); F, palp (× 200); G, front tarsus and metatarsus (× 200); H, dorsal setae (× 860).

setae of two kinds, the larger rather stout and rodlike with strong setules and to 50μ long, the smaller to 20μ long, more slender and tapering with long setules.

Loc. Two co-types from an ants' nest, Glen Osmond, S. Aust., 10th Sept., 1933 (H.W.). Other specimens from Glen Osmond, S. Aust., 17th Sept., 1933, 1st Oct., 1933, 29th July, 1934, Aug., 1935; Burnside, S. Aust., 17th Oct., 1934.

Also Julia Percy Is., New S. Wales, Feb., 1936 (A.T.) described as *M. tubbi*, and from Gympie, Queensland, 27th May, 1940 (D.J.W.S.), recorded as *Echin. hystricinum* Canest.

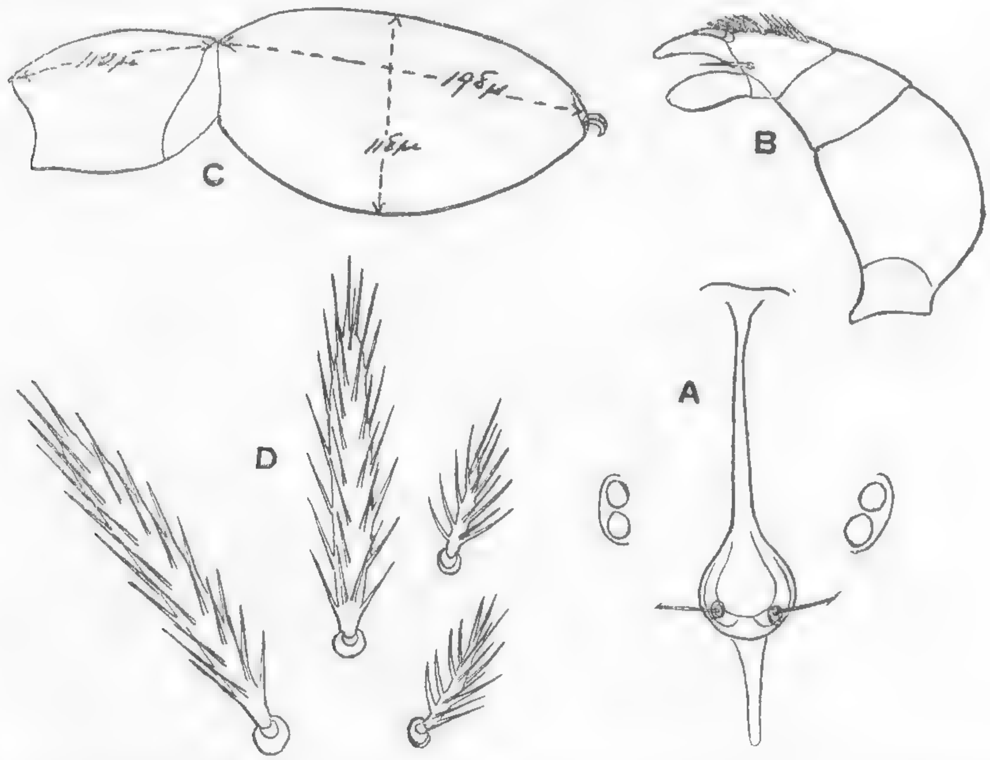

Fig. 15. *Microtrombidium adelaidicum* Wom. A, Crista and eyes (× 200); B, palp (× 200); C, front tarsus and metatarsus (× 200); D, dorsal setae (× 860).

Remarks. From the clear figures of the dorsal setae of *hystricinum* given by Vitzthum (Treubia, 1928), the above species is superficially very close to the New Guinea form, and may be but a variation of it. The Australian specimens, however, differ in the very much shorter dorsal setae (see key) as well as in the slightly different proportions of the front tarsi and metatarsi; for the present I would regard them as a different species.

MICROTROMBIDIUM JABANICUM Berl.

Microtrombidium pusillum v. *jabanicum* Berlese, 1910, Redia, 6, 362.

Microtrombidium jabanicum Berl., 1912. Redia, 8, 139–140; Oudemans, 1922, Entom. Ber., 6, 108; Vitzthum, 1926, Treubia, 8 (1–2).

Fig. 16 A–E.

A single specimen collected from soil surface in kunai grass, Dobodura area of New Guinea by Fl./Lt. D. C. Swan is, I believe, referable to this species. The description of the specimen, an adult female, is as follows:

Length 1·2 mm., width 0·85 mm. Shape only slightly cordate. Colour a deep purplish-red or maroon. Crista linear, 324μ long, and tapering towards

apex, with a subposterior sensillary area at about ⅔ from apex, sensillae ?, the bases 25μ apart. Eyes 2+2, on well defined ocular shields, well in advance of sensillary area. Chelicerae with finely serrate inner edge. Palpi stout, tibia with apical claw, smaller accessory claw, two pectines and a short, stout, external spine. Legs shorter than body, I 900μ, II 660μ, III 660μ, IV 900μ; tarsus I 216μ long by 122μ high, $T_l/T_w = 1 \cdot 77$, metatarsus I 144μ long, $T_1/M_1 = 1 \cdot 5$. Dorsal setae of uniform type, mainly stout with long setules and to 20μ long; on the propodosoma near crista and near the suture, as well as at the posterior end of hysterosoma they are somewhat longer, to 25μ.

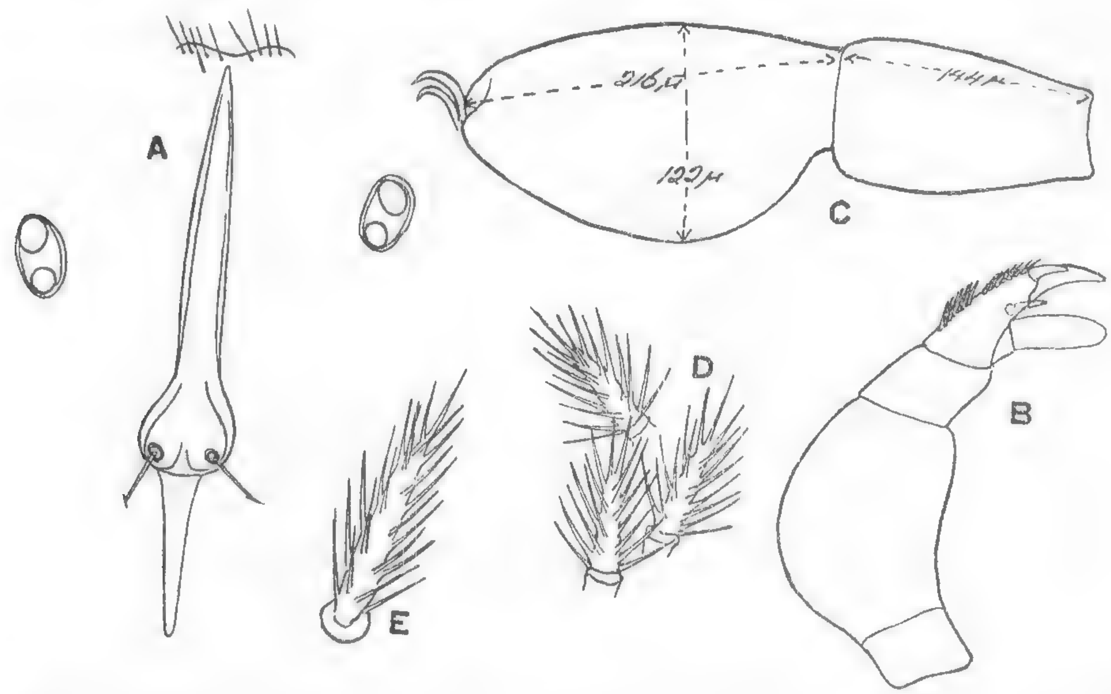

Fig. 16. *Microtrombidium jabanicum* Berl. A, Crista and eyes (× 200); B, palp (× 200); C, front tarsus and metatarsus (× 200); D, dorsal setae from disc of hysterosoma (× 860); E, dorsal seta from propodosoma near crista (× 860).

Loc. Four females and three males from damp soil in typhus area, Goodenough Is., Aug., 1944 (D.C.S.).

Remarks. In the dimensions of the front tarsi and metatarsi this species is very near to *karriensis* but differs in that the clothing of the dorsum is very much denser, the setae are stouter, the colour of the animal is different and its form much broader across the shoulders in proportion to the length.

It may, possibly, be the same as *agilis* Canestrini from Finschhafen but the brief description of that species does not permit of comparison.

MICROTROMBIDIUM GOODENOUGHENSIS sp. nov.

Fig. 17 A–D.

Description. Adult. Length to 0·93 mm., width 0·63 mm. Colour in life red. Shape egg-like, somewhat broader across shoulders. Crista linear, 260μ, with subposterior sensillary area, at about ¾ from apex, posterior arm evanescent, sensillae very long and filamentous, nude, 216μ long, bases 40μ apart. Eyes 2+2, on distinct shields and in advance of sensillary area, apex of crista with ca. 6 long finely ciliated setae. Chelae with finely serrate inner edge. Palpi

fairly stout, tibia with apical claw, smaller accessory claw, two pectines, but no external spine. Legs not longer than body, I to 900μ, II 630μ, III 630μ, IV 930μ; tarsus I elongate, 240μ long by 108μ high, $T_1/T_w = 2 \cdot 22$, metatarsus 144μ long, $T_1/M_1 = 1 \cdot 66$. Dorsal setae only moderately dense, 20μ, uniform on both propodosoma and hysterosoma, fairly slender with long setules, pointed.

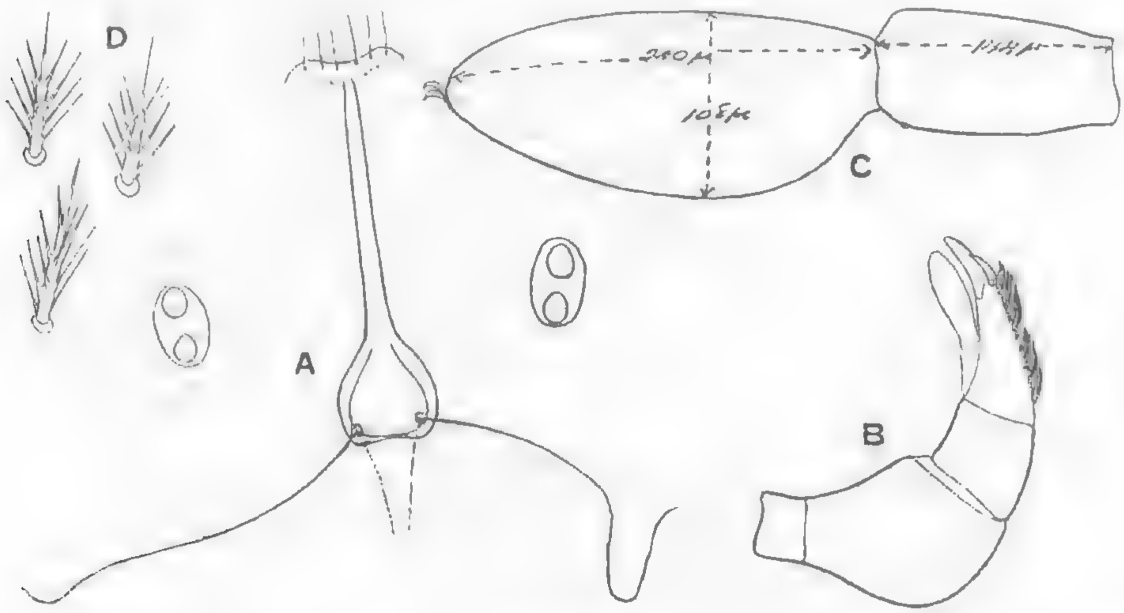

Fig. 17. *Microtrombidium goodenoughensis* sp. n. A, Crista and eyes (× 200); B, palp (× 200); C, front tarsus and metatarsus (× 200); D, dorsal setae (× 860).

Loc. Two specimens in damp soil, Goodenough Is., Aug., 1944 (D.C.S.).

Remarks. In the form and length of the dorsal setae, and the absence of an external spine on the palpal tibia this species closely resembles *pusilla* Herm. from Europe. It differs, however, in the dimensions of the front tarsi and metatarsi.

MICROTROMBIDIUM CORDATUM sp. nov.

Fig. 18 A–F.

Description. Adult ♀. Shape cordate, relatively broad and short. Length to 1·65 mm., width across shoulders 1·2 mm. Colour a uniform deep purplish red or maroon. Crista linear, to 340μ long, with subposterior sensillary area at about ⅔ from apex, anterior sinuous edge of evanescent anterior plate with numerous fine ciliated setae; sensillae long, 180μ, apparently nude, the bases 29μ apart. Eyes 2+2, on well developed ocular shields and well in advance of sensillary area. Chelicerae with finely serrate inner edge. Palpi not very stout, tibia with apical claw less than half its length, accessory claw, two pectines and a long slender external spine which arises much nearer the base of claw than the base of tarsus; tarsus elongate, barely reaching tip of claw. Legs shorter than body, I 900μ, II 620μ, III 620μ, IV 870μ; tarsus I 223μ long by 122μ high, $T_1/T_w = 1 \cdot 83$, metatarsus I 140μ long, $T_1/M_1 = 1 \cdot 59$. Dorsal setae very dense and strongly pigmented, 20μ, uniform, fairly thick stemmed, with long setules (cf. fig. 18 E–F), those on the propodosoma and near suture and on apex of hysterosoma reaching to 30μ long.

Adult ♂. Generally only differing in size. Length to 0·9 mm., width to 0·62 mm. Tarsus I 151μ long by 86μ high, $T_l/T_w = 1{\cdot}75$, metatarsus I 83μ long, $T_1/M_1 = 1{\cdot}82$. Otherwise as in female.

Loc. Four females and three males from damp soil in typhus area, Goodenough Is., New Guinea, Aug., 1944 (D.C.S.).

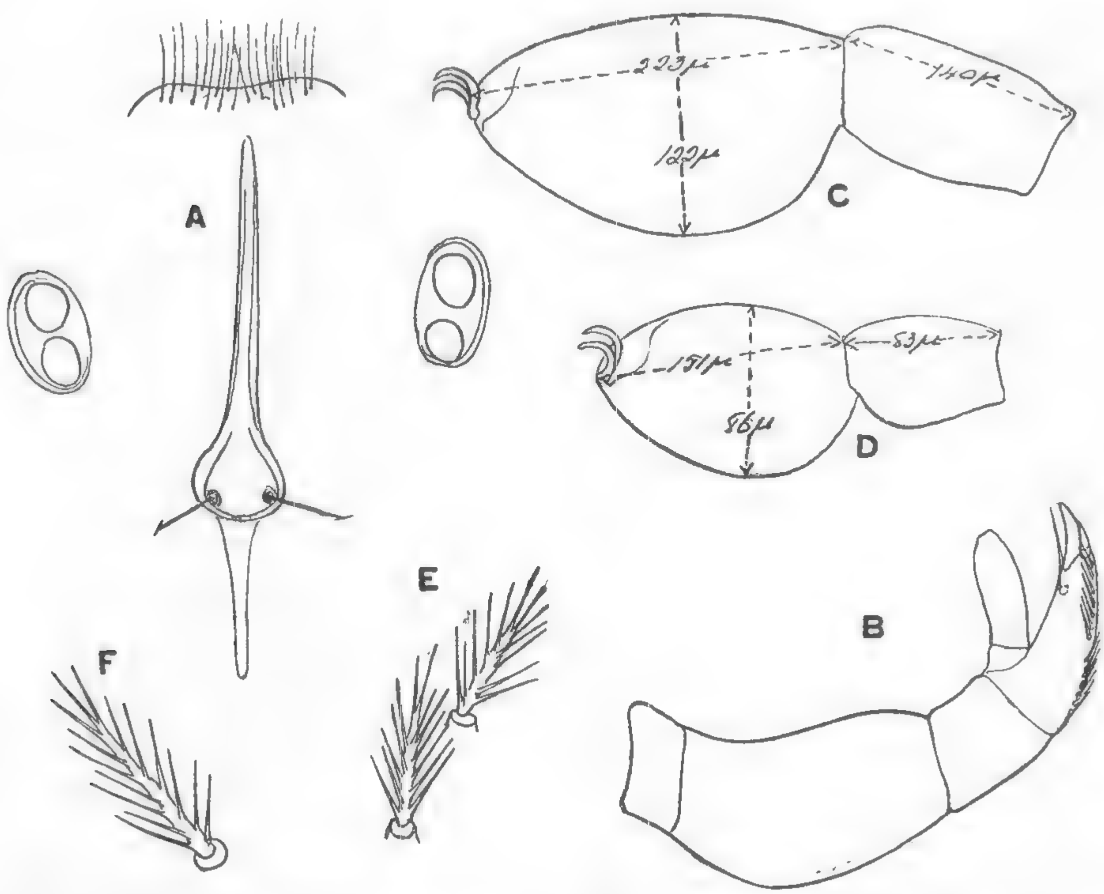

Fig. 18. *Microtrombidium cordatum* sp. n. A, Crista and eyes (× 200); B, palp (× 200); C, front tarsus and metatarsus of female (× 200); D, same of male (× 200); E, setae from middle of dorsum (× 860); F, seta from propodosoma (× 860).

KEY TO THE ABOVE SPECIES OF *Microtrombidium* s.str.

1. Front tarsus more or less elongate, about twice or more than twice as long as high .. 2.
Front tarsus distinctly less than twice as long as high .. .. .. 7.

2. Front tarsus more than 3 times as long as high .. .. 3.
Front tarsus about twice or to 2¼ times as long as high 4,

3. On external side of palpal tibia with two strong spines arising from near articulation of tarsus. $T_l/T_w = 3{\cdot}1$, $T_1/M_1 = 1{\cdot}54$. Dorsal setae uniform to 24μ, tapering with long setules .. .. *zelandicum* Wom. 1936.
On external side of palpal tibia with only one spine, this short and stout. $T_l/T_w = 3{\cdot}36$. $T_l/M_l - 1{\cdot}67$. Dorsal setae of two distinct sizes, 25μ and 50μ thick, with long setules, the longer setae appearing clavate or bushy .. .. .. *myloriense* sp. nov.

4. No external spine on palpal tibia .. .. 5.
One external spine of palpal tibia .. .. 6.

5. Front tarsus only slightly longer than metatarsus, $T_1/M_1 = 1{\cdot}27$. $T_l/T_w = 2{\cdot}26$. Dorsal setae uniform to 40μ, slightly tapering, with long setules .. *affine* Hirst 1928.
Front tarsus about 1½ times as long as metatarsus, T_1 $M_1 = 1{\cdot}66$, $T_l/T_w = 2{\cdot}22$. Dorsal setae uniform, to 20μ (near suture to 36μ), tapering with long setules
goodenoughensis sp. nov.

6. External spine of palpal tibia long and slender. $T_1/T_w = 1{\cdot}92$, $T_1/M_1 = 1{\cdot}57$. Dorsal setae uniform to 16μ, tapering with long setules .. .. cf. *aequalis* (Bks. 1916).
External spine of palpal tibia thick. $T_1/T_w = 2{\cdot}12$, $T_1/M_1 = 1{\cdot}76$. Dorsal setae uniform, slender and tapering, with long setules, varying from 40μ to 80μ, but without demarcation into two sizes .. .. *wellingtonense* sp. nov.

7. Colour red, with eleven rounded white patches on dorsum. Front tarsus broadly ovate, $T_1/T_w = 1{\cdot}74$, $T_1/M_1 = 1{\cdot}62$. Dorsal setae uniform, fairly thick stemmed, to 25μ, with long setules .. .. *maculatum* Wom. 1942.
Colour entirely red, or purplish red .. .. 8.

8. Dorsal setae of two distinct lengths .. .. 12.
Dorsal setae uniform in length, or if increasing posteriorly, then not in two distinct sizes 9.

9. Front tarsus elongate oval, highest in the middle. $T_1/T_w = 1{\cdot}93$, $T_1/M_1 = 1{\cdot}5$. External spine on palpal tibia long and strong. Dorsal setae very dense, uniformly long and slender, 40–75μ, with long setules .. .. *hirsutum* sp. nov.
Front tarsus relatively shorter and higher with the highest point nearer the base .. 10.

10. External spine of palpal tibia short and stumpy. $T1/Tw = 1{\cdot}76$, $T_1/M_1 = 1{\cdot}6$. Dorsal setae thick, hardly tapering, with long setules, chiefly to 20μ long, but near crista and suture and on apex of hysterosoma to 25μ .. .. .. *jabanicum* Berl. 1910.
External spine of palpal tibia long and slender .. .. 11.

11. Smaller species, more elongate. Red. Tibial claw of palp almost as long as tibia, external tibial spine slender, arising near articulation of tarsus and reaching to middle of claw. Dorsal setae rather slender, uniform, 25–30μ long, occasionally to 40μ, with long outstanding setules. $T_1/T_w = 1{\cdot}7$ to $2{\cdot}31$ (aver. 1·9), $T_1/M_1 = 1{\cdot}73$ to $2{\cdot}25$ (aver. 1·87).
karricensis Wom. 1931.
Larger species, cordate. Purplish. Tibial claw of palp less than half as long as tibia, external spine arising near base of claw, long and slender, and almost reaching tip of claw. Dorsal setae stouter, uniform, 20μ, with long setules, those on suture and apex of hysterosoma reaching 30μ. $T_1/T_w = 1{\cdot}83$, $T_1/M_1 = 1{\cdot}59$. .. .. *cordatum* sp. nov.

12. The longer dorsal setae more clustered near apex of hysteroma and not on disc, to 32μ; smaller setae 16μ, rather thick, slightly curved and with short setules, longer setae more rod-like with short setules. $T_1/T_w = 1{\cdot}61$ to $1{\cdot}88$ (aver. 1·72), $T_1/M_1 = 1{\cdot}41$ to $1{\cdot}71$ (aver. 1·55) .. .. *papuanum* sp. nov.

13. The longer dorsal setae to 70μ and distally split longitudinally for 1/5 to 1/7 of their length, with comparatively short setules. Shorter setae tapering, 16–20μ long, with relatively longer setules. Front tarsus rather less than twice as long as high = 1·66, highest about the middle and 1·66 times as long as metatarsus. External spine of palpal tibia fine and slender
cf. *furcipile* (Canest. 1897).
The longer dorsal setae not thus split distally .. .. 14.

14. Longer dorsal setae sparse, clavate or bushy distally, to 80μ long with long setules. Smaller setae tapering, to 21μ long, with curved setules. Front tarsus oval, $T_1/T_w = 1{\cdot}68$, highest in middle, $T_1/M_1 = 1{\cdot}86$. No external spine on palpal tibia .. *newmani* Wom. 1934.
Longer dorsal setae not clavate .. .. 15.

15. Longer dorsal setae to 80μ, the shorter to 30μ. $T_1/T_w = 1{\cdot}75$, $T_1/M_1 = 1{\cdot}6$. Dorsal setae with relatively short setules (after Vitzthum) .. *hystricinum* (Canest. 1897).
Longer dorsal setae to 50μ, shorter to 16–20μ, with relatively short setules. $T_1/T_w = 1{\cdot}68$, $T_1/M_1 = 1{\cdot}77$. External spine of palpal tibia slender
adelaidicum Wom. 1934 (= *tubbi* Wom. 1942).

Genus Camerotrombidium Sig Thor, 1936.

Zool. Anz. 1936, 114, 31.

Microtrombidium Boshell and Kerr, 1942 (in part) Rec. Ac. Columb. Ci. Ex., 5, 110–127.

This genus was erected by Sig Thor for those species of Microtrombidiinae in which the dorsal setae, or at least the larger setae where there are two sizes, are chambered and septate, but are not curved or bent over, as in the genus *Campylothrombium* Krause, 1916.

He cited *Trombidium pexatum* (C. L. Koch, 1937) (= *calcyigerum* Berl., 1910) as the genotype and included the following species; *purpureum* (C. L.

Koch, 1837) (= *sanguineum* Berl., 1887, in part); *sanguineum* (C. L. Koch, 1837) (= Berl., 1887, in part) (= *subrasum*, Berl., 1910); *barbatum* (Lucas, 1849); *vesiculosum* (Sig Thor, 1900), *curtulum* (Berl., 1910); *diversum* (Berl., 1910), *clavodigitatum* (Berl., 1916); *kerrillei* (André, 1932); *k.* var. *diversipalpis* (André, 1932); *collinum* (Hirst, 1928); *simile* (Hirst, 1928); *hirsti* (Womersley, 1934).

Later (Zool. Anz., 115 (3/4), 106) he described *C. globiferum* from Mauritius, and in the same paper cited *Ottonia vesiculosa* Sig Thor, 1900, as a new genotype of *Camerotrombidium* Sig Thor, 1936.

The following seven species are known to occur in Australia, two of which, and a variety, are here described as new.

CAMEROTROMBIDIUM SIMILE (Hirst, 1928).

Microtrombidium (*Enemothrombium*) *simile* Hirst, 1928. P.Z.S. 1024, fig. 2. A.C.D.F.G.H.; Womersley, 1934. Rec. S. Aust. Mus., 5 (2), 195, *nec* Womersley, 1936, J. Linn. Soc. London (Zool.) 40, (269), 109.

Microtrombidium (*Enemothrombium*) *hirsti* Womersley, 1934, Rec. S. Aust. Mus., 5 (2), 196, fig. 46–47.

Camerotrombidium simile Sig Thor, 1936, Zool. Anz., 114, 31; Womersley, 1937. Rec. S. Aust. Mus., 6 (1), 92.

Camerotrombidium hirsti (Womersley 1934), Sig Thor, 1936, Zool. Anz., 114, 31; Womersley, 1937, Rec. S. Aust. Mus., 6 (1), 92.

Fig. 19 A–K and 20 A–E.

Redescription of Adult. Fig. 19 A–K. Shape as in outline fig. 19A, hysterosoma roughly oblong, wider anteriorly across the rounded shoulders, posteriorly rounded; propodosoma somewhat triangular, basally much narrower than anterior margin of hysterosoma into which it is slightly sunken and from which it is separated by a transverse posteriorly concave sulcus. Colour entirely red but with a light whitish dusting, especially on the legs, due to the setae. Length to 2·71 mm., width across shoulders to 1·46 mm. Crista, Fig. 19B, elongate but moderately broad and tapering anteriorly, with subposterior sensillary area at about ⅔ from apex, length to 600μ, sensillary bases 54μ apart, sensillae ca. 200μ long, filamentous, apparently nude. Eyes 2+2, on well developed ocular shieds, posterior eyes the smaller. Legs all shorter than the body, I 2175μ, II 1380μ, III 1350μ, IV 2250μ; tarsus I (Fig. 19 D) elongate oval to 450μ long by 180μ high = 2·5 ratio, metatarsus I to 345μ long, ratio length of tarsus to metatarsus = 1·3. Palpi, Fig. 19 C, stout, tibia with stout apical claw and smaller stout accessory claw, two pectines, and on external side with 2–4 stout strong spines arising near base of palpal tarsus (Hirst says 2 to 3 spines, but the number is variable, even in the same specimen and sometimes one may be more slender); tarsus elongate, hardly clavate and only very slightly exceeding tip of tibial claw.

Clothing dorsally on propodosoma mainly and on hysterosoma entirely of two forms and sizes; the larger, Fig. 19 E–F, to 50μ long, globose or subglobular, thistle-like with a distinct chamber marked off by a septum, apically above the septum open and with a distinct whorl of setules, otherwise evenly with long ciliations, arising from a rosette-like tubule; the smaller cup-shaped (Fig. 19 G), 18–20μ long, arising from a rosette-like tubule, with fine ciliations and in some views showing distinctly the lateral margins of the scale which is apparently curled to form the cup (see Fig. 19 G); on the propodosoma laterally above the anterior pairs of coxae are a number of small, 21μ, ciliated, pointed setae (Fig. 19 H), which dorsally appear fusiform, but ventrally show distinctly a clear space and the

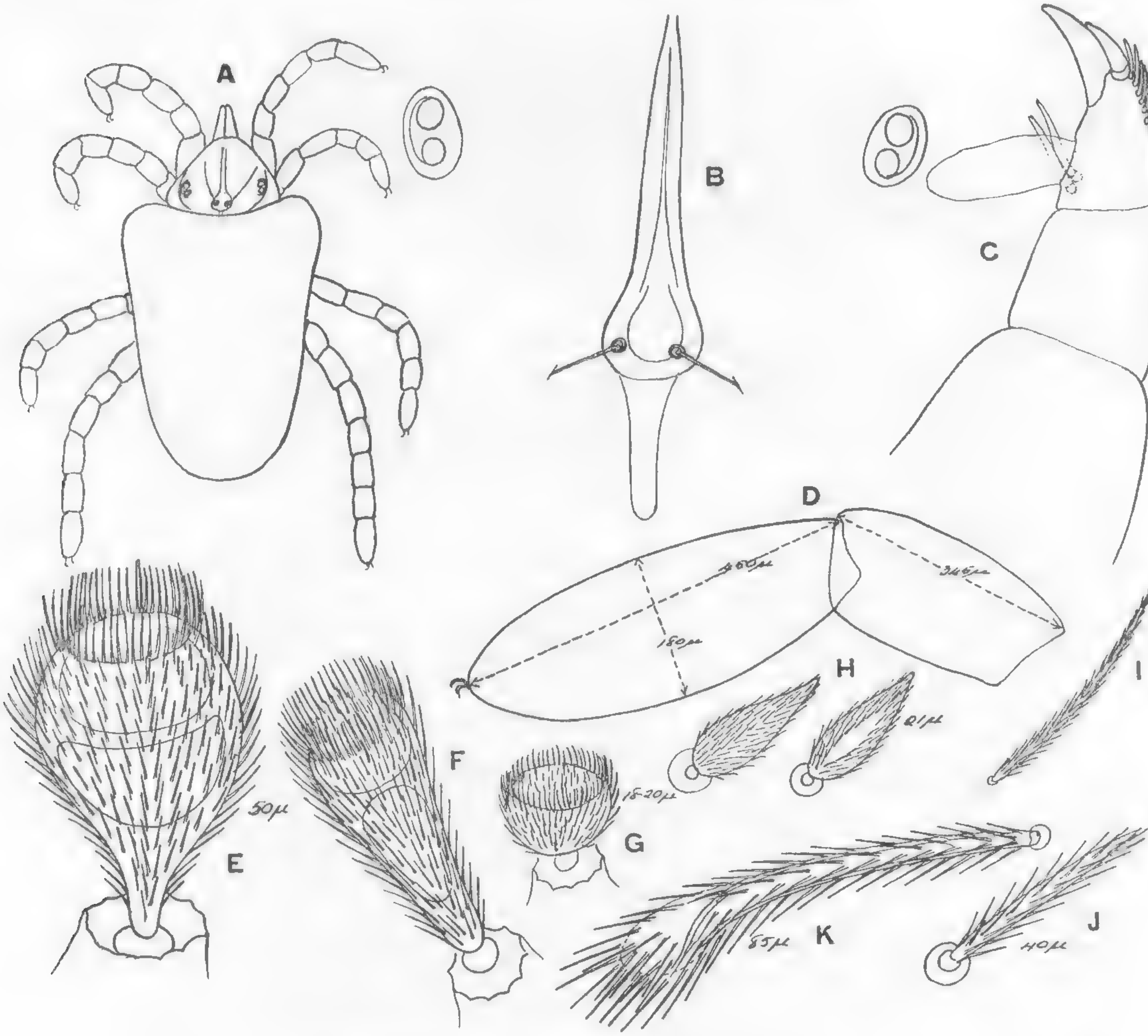

Fig. 19. *Camerotrombidium simile* (Hirst) adult. A, Dorsal view in outline; B, crista and eyes (× 125); C, palp (× 200); D, front tarsus and metatarsus (× 125); E, large seta from apex of hysterosoma; F, same from anterior of hysterosoma; G, small seta from hysterosoma; H, dorsal and ventral views of small setae from lateral areas of propodosoma; I, seta from in front of apex of crista; J, ventral setae from anterior of genital organ; K, seta from basal segments of legs (E to K × 860).

edges of the longitudinally curled scale of which they are formed; the larger septate setae (Fig. 19 F), anteriorly on the propodosoma, are more elongate and not so globose as elsewhere; at the apex of the propodosoma in front of the tip of the crista is a fringe of long pointed slender ciliated setae (Fig. 19 I); ventrally from between the genital and anal openings the setae are of two kinds as on the hysterosoma, anteriorly they are long, fairly stout, ciliated (Fig. 19 J) to 40μ, and gradually becoming smaller towards the genital opening where they resemble Fig. 19 H; the legs dorsally and dorsolaterally on all segments, and the palpal femora are furnished with somewhat clavate, ciliated setae, which on the basal leg segments reach to 85μ in length (Fig. 19 K), but elsewhere are shorter; otherwise the appendages with long fine slender ciliated setae.

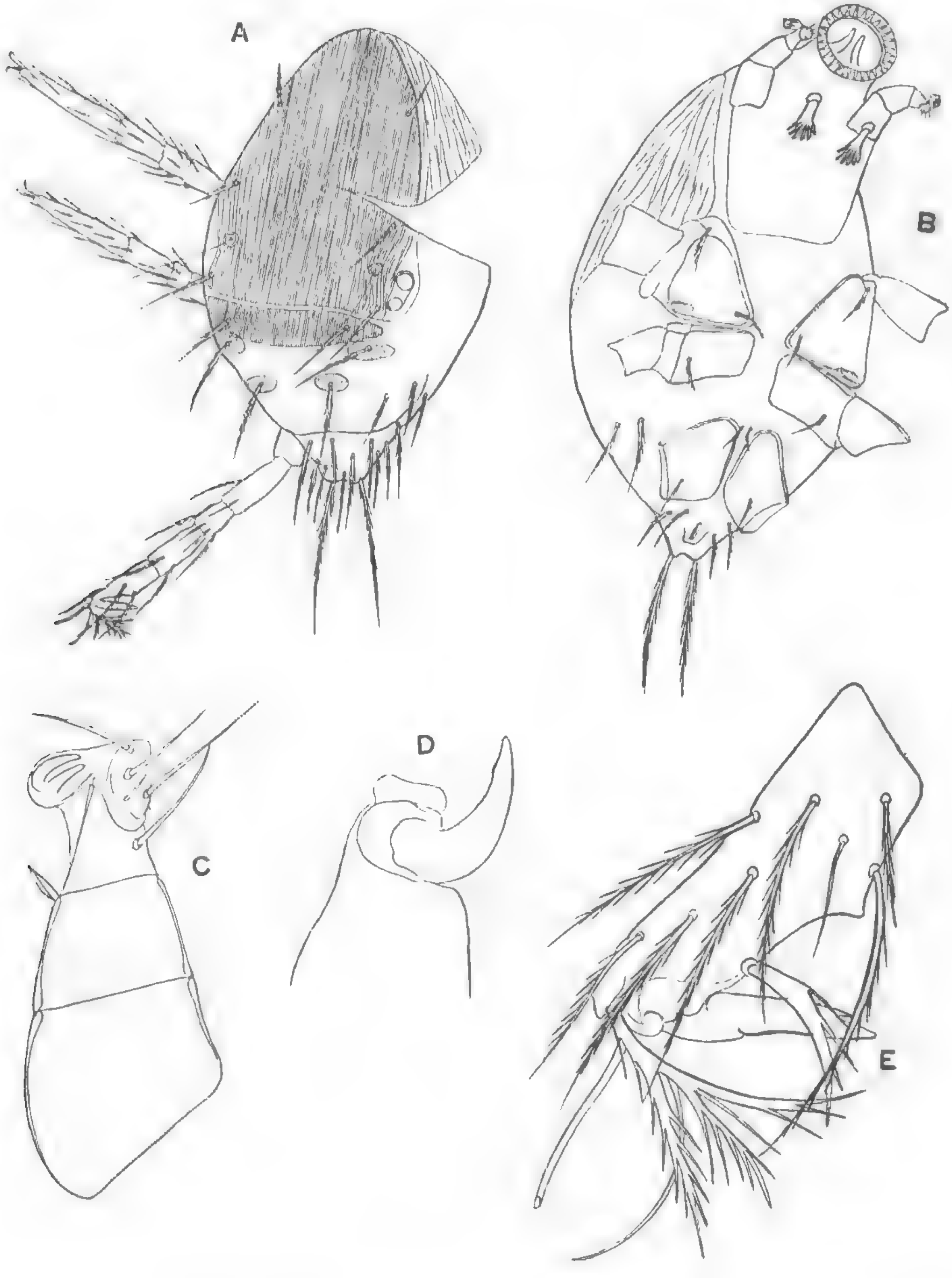

Fig. 20. *Camerotrombidium simile* (Hirst) larva. A, dorso-lateral view; B, ventro-lateral view; C, palp; D, chelicera; E, tarsus of leg III.

Loc. Type material (in S. Aust. Museum) from Belair, S. Aust., Jan. 1, 1928 (S. Hirst); other specimens from South Australia: Sou'-West River, Kangaroo Is., Dec., 1934 (H.W.), (3 spec.); Wood's Point, May, 1935 (H.W.), (1 spec.); Mt. Gambier, Jan., 1941 (J.S.W.), (1 spec.); Coorong, April, 1943 (H.W.), (a number); Robe, Oct., 1943 (H.W.), (1 spec.). New South Wales: Myall Lakes, Sept., 1922 (A. Musgrave), (1 spec.).

Remarks. The specimen from New South Wales was amongst the Hirst material left in Adelaide and was that from which *C. hirsti* (Wom., 1934) was described. I am now satisfied, however, that the specimen does not differ essentially from typical *simile* Hirst.

Description of Larvae. Fig. 20 A–E. Colour in life reddish. Shape rather ovoid, tapering posteriorly and apex incised, higher than wide. Length to 300μ, width to 165μ. Legs shorter than body, I 270μ, II 225μ, III 240μ. Dorsally with two anterior median scuta, the anterior very large, 184μ long by 128μ wide, longitudinally striated, occupying nearly the whole width of dorsum and extending backwards to level of between first and second coxae, anteriorly it overlaps on to the venter and this portion has the longitudinal striae much wider apart (cf. Fig. 20 A–B); this scutum has 3 pairs of short stout setae, 32–40μ long and ciliated, as well as a pair of long filamentous sensillae, 72μ long, and with bases 105μ apart; the second scutum is transverse, as wide as the first, but only 34μ long, with two setae, 40μ long, and ciliated. Eyes 2+2, the anterior eyes on a level with sensillae. Behind the second anterior scutum are four strong ciliated setae, about 50μ long, set in the centre of small pitted oval plates, these are followed by about 16 setae of which the last pair are 80μ long. Mandibles long, with the chelae as in Fig. 20 D. Palpi apparently 4-segmented, stout, tarsus short and rounded with 3 long and 1 short simple setae, tibia with curved hook-like claw, which appears almost bifurcate. The oral opening is circular, formed of a pair of semicircular lobes set with teeth (in the figure 20 B, the lobes have become displaced and only one is seen). Ventrally, gnathosoma with a pair of short stout fimbriated setae, coxae I and II forming two lateral groups, separated in medial line, III practically touching medially, I with two pairs of short ciliated, tapering setae, II and III with 1 pair; no setae between coxae I or II, but a pair of short setae between coxae III at anterior corners. Tarsi and claws of legs I and II normal, those of III with the outer claw deformed as in Fig. 20 E.

Loc. Several larvae were found during Oct. 1943 in a tube in which an adult, collected from the Coorong, S. Aust., April, 1943, had been confined with a small amount of sterilized soil. No eggs were seen. Two specimens were mounted.

Remarks. In the form of the mouth parts, dorsal scuta and the third tarsus this species agrees with those placed by Oudemans (1912) as of the genus *Thrombidium* Fabr., 1775. Of the species so placed by Oudemans, however, none are known from the adult forms, and indeed he states on p. 112, that they are only provisionally placed in *Thrombidium*.

In the two species, which Oudemans figures, viz. *demeijerei* Ouds. and *africanum* Ouds. the third pair of coxae are distinctly and widely separated. Assuming this difference to be valid the larval generic diagnosis of *Camerotrombidium* may be stated as follows:

Trombidiidae with the characteristic pseudostigmal opening between coxae I and II. Eyes 2+2. Two median dorsal scutum, anterior with 3 pairs of setae and 1 pair of sensillae, anteriorly overlapping on to venter; posterior with 2 setae; both longitudinally striated. Coxae I and II touching, separated in medial line, III touching more or less completely in median line. Oral opening circular. Palpal tibia with hook-like claw. Outer claw of tarsus III deformed.

CAMEROTROMBIDIUM COLLINUM (Hirst, 1928).

Microtrombidium (Enemothrombium) collinum Hirst, 1928. Ann. Mag. Nat. Hist. (10), 1, 565; Womersley, 1934. Rec. S. Aust. Mus. 5, (2), 195.

Camerotrombidium collinum Sig Thor, 1936, Zool. Anz., 114, 31; Womersley, 1937. Rec. S. Aust. Mus., 6 (1), 92.

Fig. 21 A–F.

Redescription. Colour red. Shape as in *C. simile* Hirst, with a distinct posteriorly convex sulcus between propodosoma and hysterosoma. Length 1·31 mm., width across shoulders 0·85 mm. Crista linear, fairly stout, 320μ long, anteriorly tapering, with subposterior sensillary area at about ⅔ from apex,

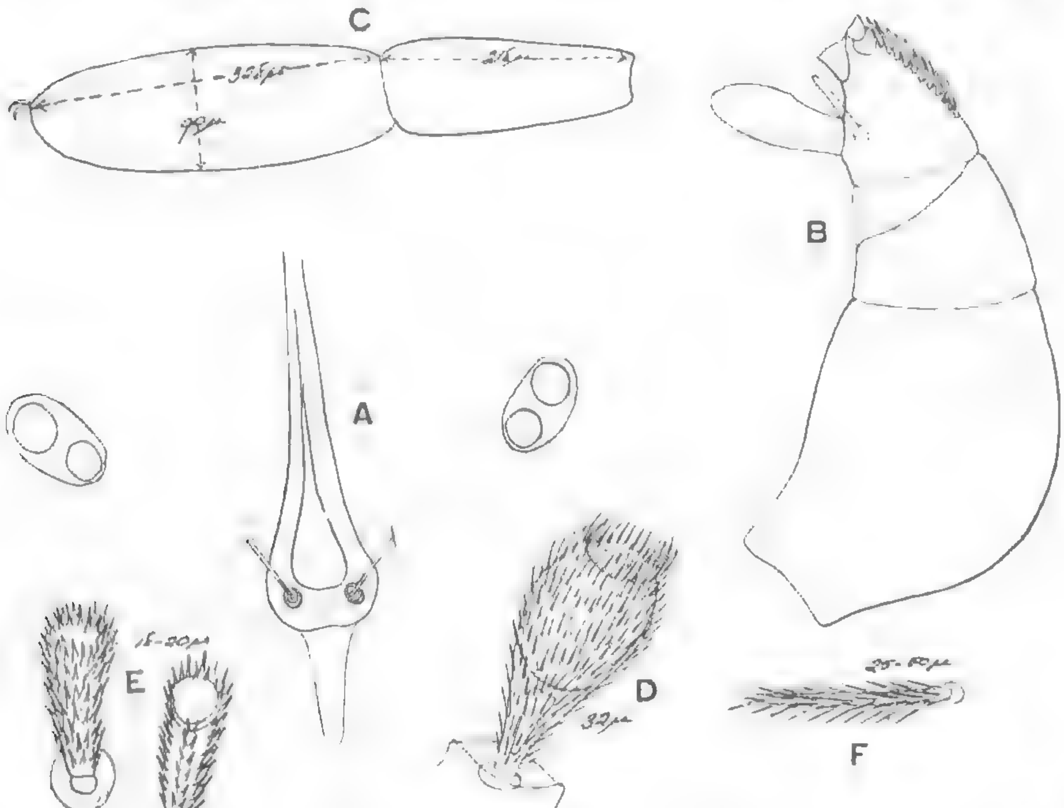

Fig. 21. *Camerotrombidium collinum* (Hirst). A, Crista and eyes (× 170); B, palp (× 200); C, front tarsus and metatarsus (× 125); D, larger dorsal seta (× 860); E, smaller dorsal setae (× 860); F, seta from edge of propodosoma and venter (× 860).

sensillae bases 36μ apart, sensillae ? Eyes 2+2, on well defined ocular shields, sessile, posterior eyes the smaller. Legs all shorter than body, I 1300μ, II 820μ, III ?, IV 1300μ, tarsi I elongate, 328μ long by 90μ high = 3·6 ratio, metatarsus I 218μ long, ratio length of tarsus to metatarsus = 1·5. Palpi (Fig. 21 B) stout, with stout tibial claw and smaller but stout accessory claw, two pectines and on external sides with a single stout spine arising near base of palpal tarsus; palpal tarsus elongate and slightly clavate.

Clothing dorsally of two kinds, the larger somewhat globose, septate, ciliated and with an oral whorl (Fig. 21 D), length to 32μ, smaller setae rather stout, 18–20μ long, slightly swollen apically with an oral opening seen ventrally, and furnished with strong spicules (Fig. 21 E); on the propodosoma the latter setae

are replaced, especially laterally, with stout, tapering, rod-like, ciliated setae (Fig. 21 F) which are about 25μ long, similar but longer setae occur on the apex of propodosoma in front of apex of crista and also compose most of the ventral clothing. The legs dorsally with setae as in *C. simile* (Fig. 19 K) and of varying lengths, otherwise with setae much as in Fig. 20 F.

Loc. Tanunda, South Australia, 23rd March, 1927 (S.H.), (the type).

Remarks. The above redescription and figures are from the type specimen in the South Australian Museum Collection. As shown in the figures the specimen is incomplete in some details, especially the palp.

CAMEROTROMBIDIUM WYANDRAE (Hirst, 1928).

Microtrombidium (Enemothrombium) wyandrae Hirst, 1928. Ann. Mag. Nat. Hist. (10), 1, 565; Womersley, 1934. Rec. S. Aust. Mus., 5 (2), 195.

Camerotrombidium wyandrae Womersley, 1937. Rec. S. Aust. Mus., 6 (1), 92. Fig. 22 A–H.

Redescription. Colour red. Shape as in *C. simile* Hirst, with a distinct posteriorly convex sulcus between propodosoma and hysterosoma. Length 2·7 mm., width across shoulders 1·5 mm. Crista linear, 600μ long, only moderately stout with subposterior sensillary area at about ⅔ from apex, sensillae bases 50μ apart,

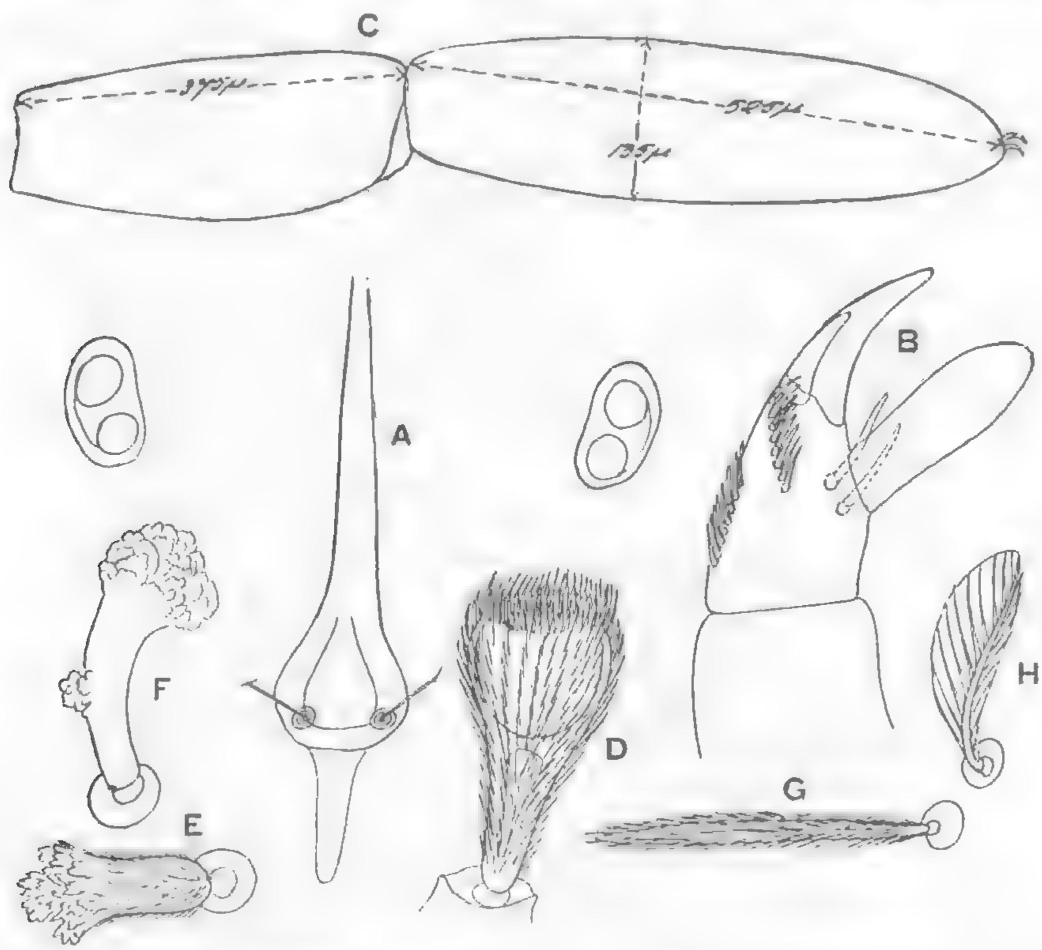

Fig. 22. *Camerotrombidium wyandrae* (Hirst). A, Crista and eyes (× 100); B, palpal tibia and tarsus (× 200); C, front tarsus and metatarsus (× 125); D, larger dorsal seta (× 860); E, smaller seta from middle of dorsum; F, smaller seta from posterior margin; G, seta from lateral area of propodosoma and venter; H, seta from dorsal surface of leg segments (E to H × 860).

sensillae ? Eyes 2+2, on well developed sessile ocular shields, anterior of sensillary area, posterior eyes the smaller. Legs shorter than body, I 2225μ, II 1450μ, III 1500μ, IV 2400μ, tarsus I elongate, parallel sided, 525μ long by 135μ high = 4·0 ratio, metatarsus 375μ long, length of tarsus to metatarsus = 1·4. Palpi as in Fig. 22 B, stout, tibia with strong apical and accessory claws, two pectines and two strong spines arising near base of tarsus on external side; tarsus elongate, only indistinctly clavate, and reaching tip of claw.

Clothing dorsally on hysterosoma of two kinds and sizes; the larger setae, 48–50μ long, are globose or thistle-like, septate (Fig. 22 D), ciliated, with an oral whorl; the smaller setae, mainly stout, rod-like, on the stem with spicules and apically expanded into a more or less tri-lobed head, the lobes of which are tubercular, on the body margin becoming curved, with a secondary tubercular lobe about the middle, and reaching a length of ca. 40μ; on the propodosoma, the setae are similar to the hysterosoma except laterally, where the smaller setae merge into ciliated rod-like setae as in Fig. 19 G, ca. 50μ long; apex of propodosoma with a fringe of long ciliated setae, ca. 70μ long; legs and palp with leaf-like ciliated setae dorsally as in Fig. 19 H; ventrally the setae are mainly short to long, rod-like and ciliated, only laterally are they of the two dorsal forms.

Loc. Wyandra, Queensland, July, 1927 (S.H.).

Remarks. The above redescription and figures are from the unique type in the South Australian Museum collection.

CAMEROTROMBIDIUM OPULENTUM sp. nov.

Fig. 23 A–F.

Description. Length to 2·7 mm., width across shoulders to 1·7 mm. Colour uniformly red. Shape as in *C. simile* (Hirst), with the usual posteriorly convex sulcus between propodosoma and hysterosoma. Crista to 630μ long, linear, rather thick, tapering anteriorly, with subposterior sensillary area at about ⅔ from apex, sensillae bases 50μ apart, sensillae ca. 150μ long, apparently nude. Eyes 2+2, on well developed sessile ocular shields, anterior of sensillary area, posterior eyes the smaller. Legs all shorter than the body, I to 1650μ, II to 1350μ, III to 1350μ, IV to 1800μ; tarsus I to 350μ long by 130μ high = ratio 2·7, metatarsus I to 290μ long, giving a ratio of length of tarsus to metatarsus of 1·21. Palpi stout, tibia with apical stout claw and smaller accessory claw, two pectines and on external side arising from near base of tarsus a pair of stout spines; palpal tarsus elongate, scarcely clavate and only sightly over-reaching tip of claw.

Clothing dorsally of two kinds and lengths of setae, the larger as in Fig. 23 D clavate, septate and strongly ciliated, to 50μ long; the smaller rod-like, Fig. 23 E, to 40μ long, and blunt ended; near shoulders and laterally on propodosoma the latter type of setae are more tapering, in front of crista on apex of propodosoma with a fringe of long fine ciliated setae to 150μ in length; ventrally entirely with long rod-like, to 40μ (Fig. 23 F), ciliated setae; legs and palpi without any specialized setae.

Loc. Four specimens from under fallen boughs, Coorong, South Australia, 5th May, 1943 (H.W.).

Remarks. A very distinctive species in the nature of the dorsal setae. The size of the four specimens, which judging by the three pairs of genital discs are all fully adult, varies considerably, as also do the dimensions of the front tarsi and metatarsi. The measurements are as follows:

Specimen 2·7 mm. long, 1·7 mm. wide; tarsus I 350μ long by 130μ high, metatarsus I 290μ long.

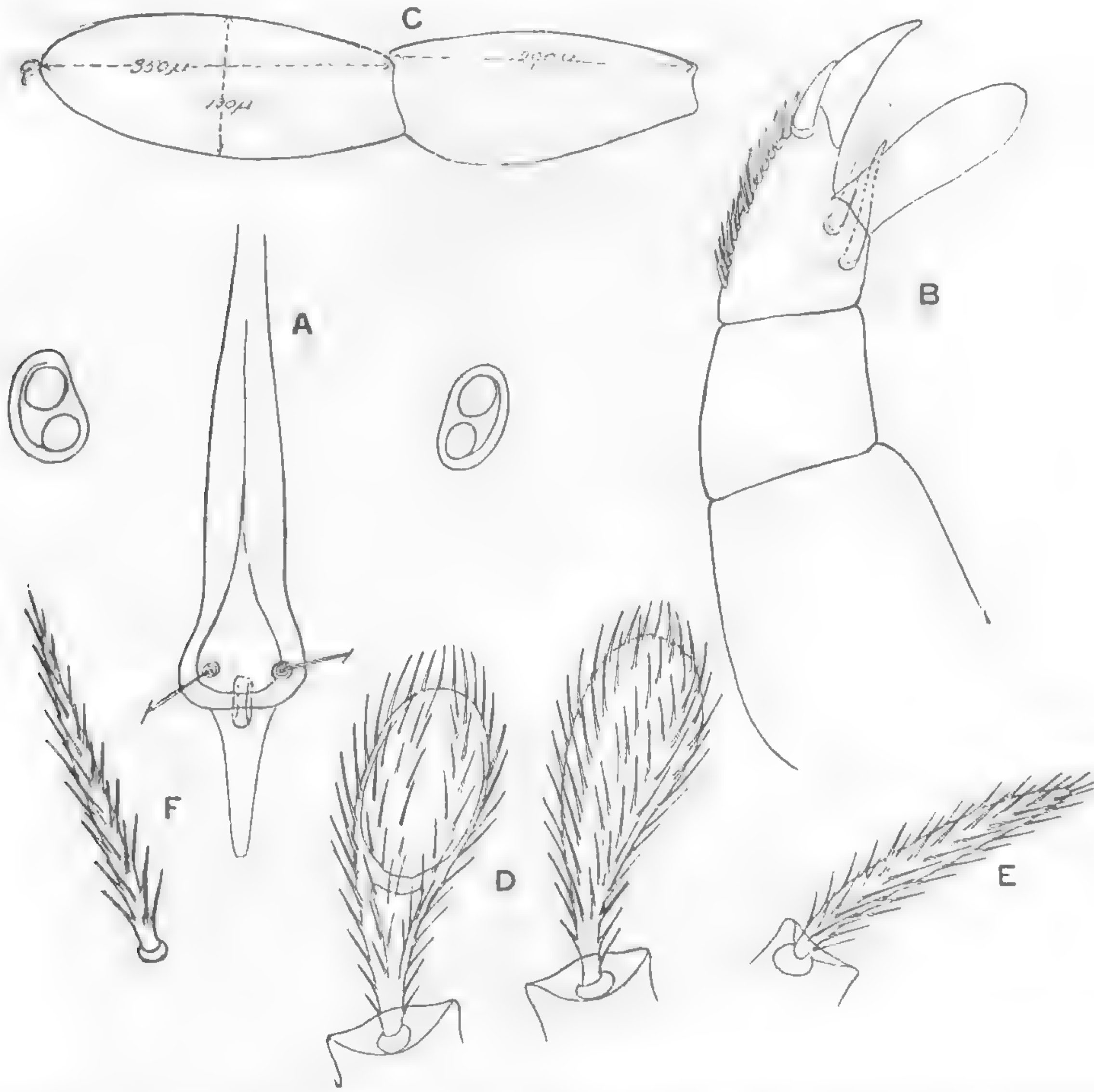

Fig. 23. *Camerotrombidium opulentum* sp. n. A, Crista and eyes (× 125); B, palp (× 200); C, front tarsus and metatarsus (× 125); D, dorsal and ventral view of dorsal seta (× 860); E, smaller dorsal setae (× 860); F, seta from anterior and lateral ventral areas of propodosoma (× 860).

Specimen 1·5 mm. long, 1·0 mm. wide; tarsus I 290μ long by 118μ high, metatarsus I 230μ long.

Specimen 1·05 mm. long, 0·75 mm. wide; tarsus I 210μ long by 75μ high, metatarsus I 150μ long.

Specimen damaged, ——; tarsus I 240μ long by 90μ high, metatarsus I 180μ long.

It is possible that the last two specimens may be of the male sex.

CAMEROTROMBIDIUM VAGINATUM sp. nov.

Fig. 24 A–G.

Description. Colour entirely red. Shape as in *C. simile* (Hirst) with the usual posteriorly convex sulcus between propodosoma and hysterosoma. Length ca. 1·5 mm., width ca. 1·05 mm. across shoulders. Crista linear, not very thick, 450μ long, with subposterior sensillary area at about ⅔ from apex, sensillae bases 40μ apart, sensillae ca. 180μ long, apparently nude. Eyes 2+2, on very slightly

pedunculate, well developed ocular shields, almost on a level with apex of crista, posterior eyes the smaller. Legs not longer than the body, fairly stout, I 1420μ long, II 775μ, III 775μ, IV 1500, tarsus I elliptical as figured, 330μ long by 150μ high — ratio of 2·0, broadest at about ⅔, metatarsus I 240μ long, ratio of length

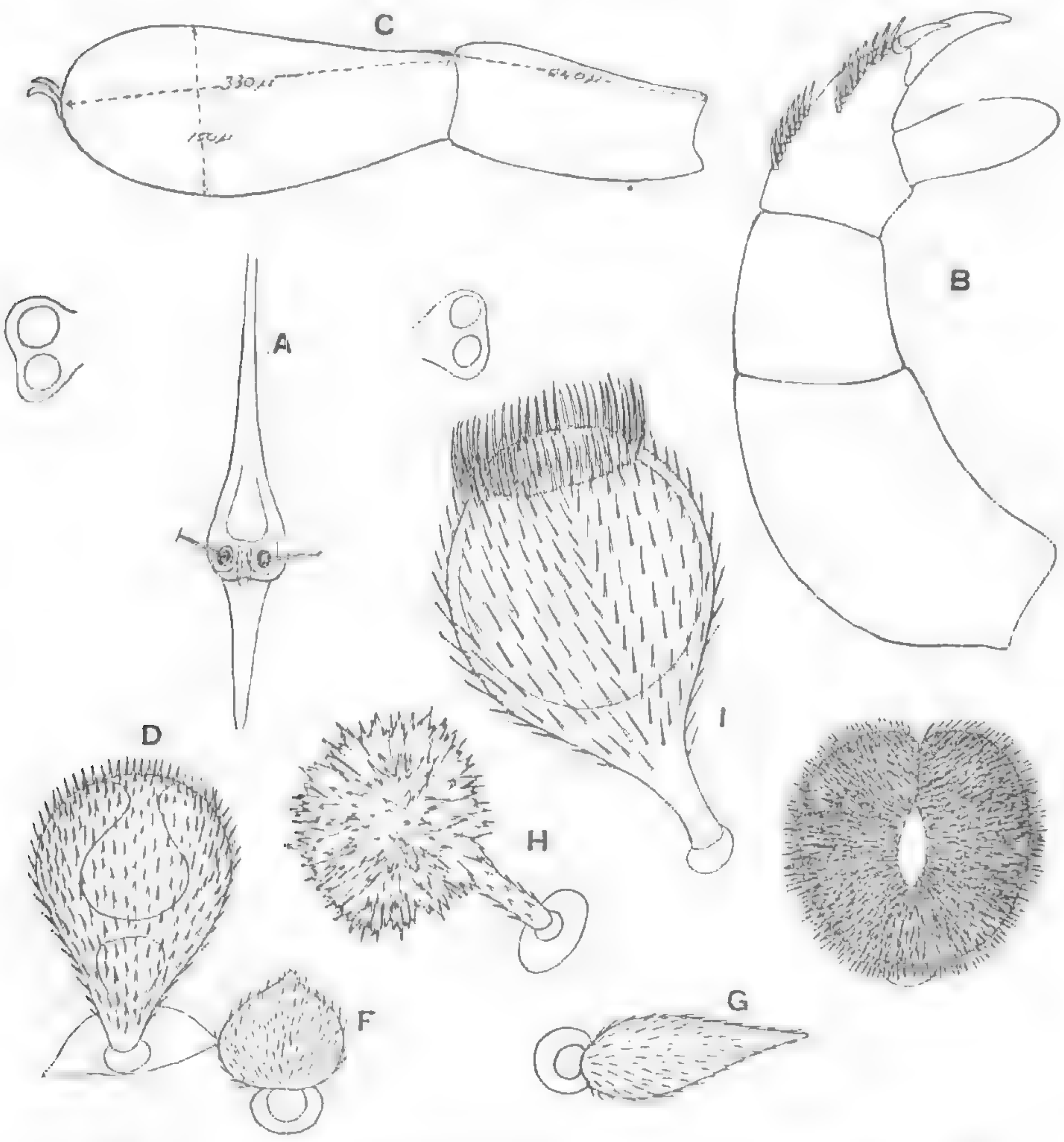

Fig. 24. A–G. *Camerotrombidium vaginatum* sp. n. A, Crista and eyes (× 125); B, palp (× 200); C, front tarsus and metatarsus (× 125); D, larger dorsal seta viewed from side; E, same seen from above; F, small dorsal setae; G, same from lateral areas of propodosoma (D to G × 860). H–I. *Camerotrombidium carduum* sp. n. adult. H, Smaller dorsal seta (× 860); I larger dorsal seta (× 860).

of tarsus to metatarsus — 1·4. Palpi only moderately stout, tibia with strong apical claw and accessory claw, two pectines, but without external spines; tarsus elongate, only slightly overreaching tip of tibial claw.

Clothing both ventrally and dorsally of two kinds and sizes: the larger to 40μ long are globose, densely furnished with short strong spinules, septate, with only small oral opening and apparently formed of an inwardly curved scale (see

Fig. 24 D, E); the smaller setae are broadly fusiform, apically slightly pointed, finely ciliated and up to 16μ long, on the propodosoma laterally the latter setae become more elongate and reach 40μ in length (Fig. 24 G), the palpal femur and legs dorsally are furnished with foliate ciliated setae as in *C. wyandrae*.

Loc. A single specimen from Flinders Chase, Kangaroo Is., South Australia, Dec., 1934 (H.W.).

Remarks. Differs from other species in the form of the dorsal setae.

Camerotrombidium carduum sp. nov.

Fig. 24 H–I.

Description. Clothing dorsally of two kinds and sizes of setae; the larger globose and thistle-like (Fig. 24 I) with a basal septa, a strong whorl orally of long ciliations, and with longitudinal rows of long strong spicules, $50–70\mu$ in length; smaller setae, 40μ in length, with a large irregular head of strong but short spicules as in Fig. 24 H.

Loc. A single specimen from Mundaring, Western Australia, Feb., 1931 (H.W.).

Remarks. Of this specimen only portions of the dorsal cuticle are now extant, but the two forms of setae are so distinct from other species, that one ventures to describe it briefly as a new species.

Camerotrombidium rasum (Berl., 1910).

Microtrombidium (Enemothrombium) rasum Berl., 1910. Redia, 6, (2), 361; *idem* 1912, Redia, 8 (1), 189. Fig. 89.

robensis var. nov.

Fig. 25 A–E.

Description. Adult. Shape as in *C. simile*, with a distinct posteriorly convex suture between propodosoma and hysterosoma. Colour in life red. Length to 1·8 mm., width to 1·2 mm. Crista linear, to 420μ long with subposterior sensillary area at about ⅔ from apex, sensillae ca. 150μ long, filamentous and apparently nude with bases 50μ apart. Eyes 2+2, on well defined sessile ocular shields. All legs except IV shorter than body, I 1650μ, II 1260μ, III 1080μ, IV 2000μ, tarsi I elongate oval, 360μ long by 160μ high = ratio of 3·11, metatarsus I 280μ long, ratio of length of tarsus to metatarsus = 1·28. Palpi as in Fig. 25 B, stout, tibia with stout apical and accessory claws, two pectines and a single strong, fairly stout external spine arising near base of tarsus; tarsus slightly clavate and slightly exceeding tip of tibial claw.

Dorsally setae uniform, small and globose, with apical opening and fringe of ciliations, otherwise uniformly ciliated, 24μ long, and arising from a rosette-like peduncle of about the same height; when carefully examined from below these setae are seen to be formed of a scale in which the lateral margins have been folded to form the globose cup-like head (see Fig. 25 D); near the apex and sides of the propodosoma are some longer, 40μ, ciliated setae as in Fig. 25 E.

Loc. Type and one paratype from under log at Robe, South Australia, April and Oct., 1943 (H.W.). Another specimen from Flinders Chase, Kangaroo Island, S. Australia, 6th Dec., 1934 (H.W.).

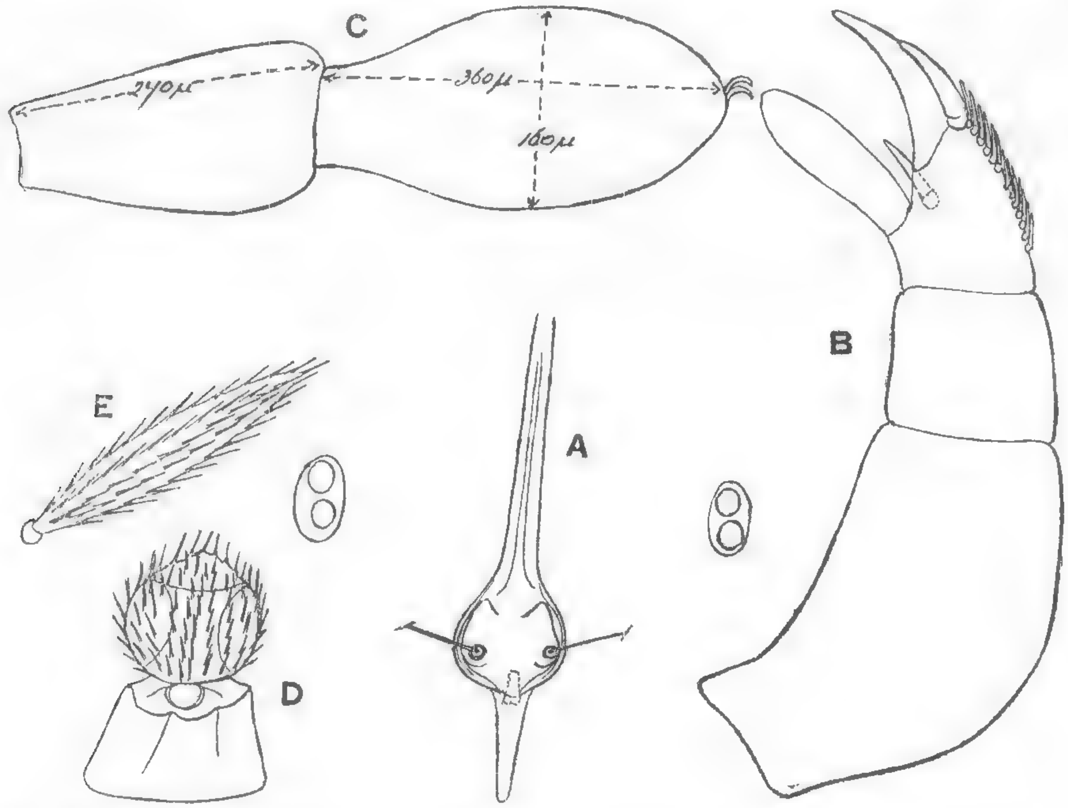

Fig. 25. *Camerotrombidium rasum* (Berl.) var. *robensis* nov. A, Crista and eyes (× 125); B, palp (× 200); C, front tarsus and metatarsus (× 125); D, dorsal seta (× 860); E, seta from near apex and sides of propodosoma (× 860).

Remarks. The above specimens are in complete agreement with Berlese's description and figures (1912) of *rasum* from Germany, in the form of the dorsal setae and the size and dimensions of the front tarsi and metatarsi. They differ, however, in the presence of an external spine on the palpal tibia. Rather than make it a new species it is referred to varietal status.

CAMEROTROMBIDIUM DISTINCTUM (Canest., 1897).

Ottonia distincta Canest., 1897. Termes. Fuzet. p. 461; *idem* 1898 Atti. Soc. Veneto-Trentina, 391, pl. 22, fig. 5, 7.

nec Microtrombidium (Enemothrombium) distinctum Berl. Redia, 8 (1), 193. Fig. 92.

Enemothrombium distinctum Ouds. 1927 Ent. Ber. 7, (156), 229.

Enemothrombium distincta Ouds. 1928. Treubia. 7, suppl. 2. 70, fig. 90–99.

Camerotrombidium distinctum Sig Thor, 1936, Zool. Anz., 114, 32.

Fig. 26 A–I.

Redescription. Shape as in *C. simile* with the usual posteriorly concave suture between propodosoma and hysterosoma. Colour in life red. Length to 1·1 mm., width to 0·6 mm. Crista linear, 234μ long with a subposterior, broad sensillary area at about ⅔ from apex, the sensillary area is longitudinally septate, sensillae long and filamentous, bases 40μ apart. Eyes 2+2, on well defined sessile ocular shields. Palpi as figured, tibia with strong apical and accessory claws, two pectines and externally a strong, stout, rather short spine; tarsus elongate, not reach-

ing tip of apical claw. Legs I 870μ, II 540μ, III 540μ, IV missing; tarsus I elongate 216μ long by 90μ high, metatarsus I 115μ long.

Dorsal setae papilliform, of two sizes, larger 14μ long, somewhat cup-like with strong setules, smaller fusiform with ciliations (fig. 26 D, E), on the legs normally with rod-like ciliated setae but on leg IV, on the trochanter (the rest of leg IV is missing on both sides) there are some setae in the form of a clasped hands with 5–7 digits.

Loc. One specimen from soil (Berlese funnel), Dobodura, New Guinea, 1944 (G. M. Kohls.) A second specimen from leaf mould, at edge of rain forest, Dobodura, Oct., 1944 (D.C.S.).

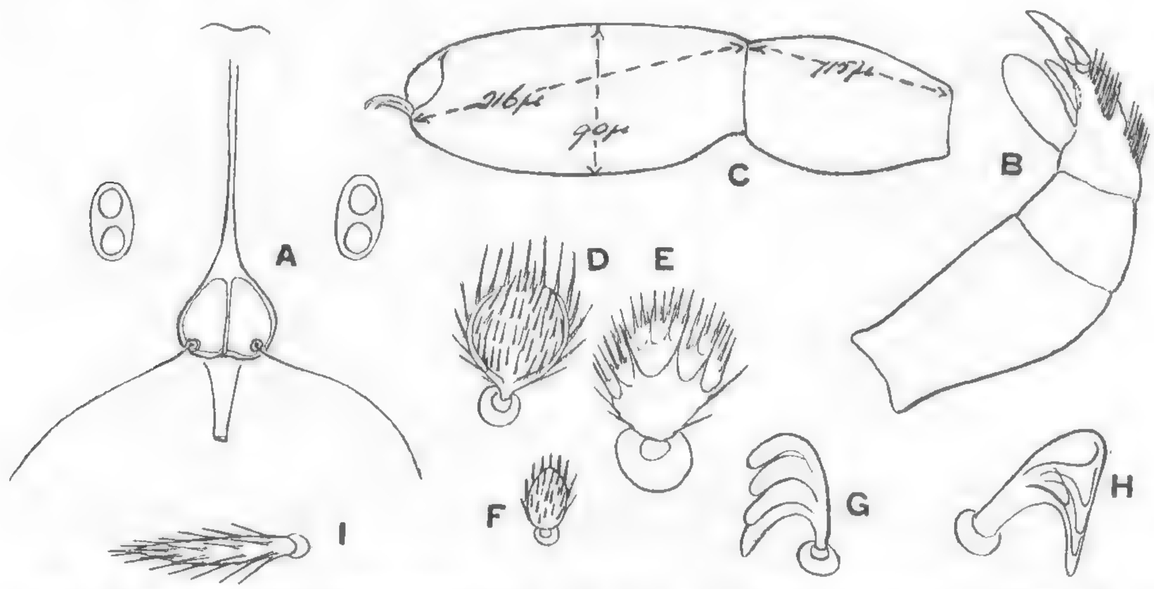

Fig. 26. ***Camerotrombidium distinctum*** (Canest). A, Crista and eyes (× 200); B, palp (× 200); C, front tarsus and metatarsus (× 200); D and E, dorsal and ventral views of larger dorsal seta (× 860); F, smaller dorsal seta (× 860); G and H, two views of the specialized setae on basal segments of leg IV (× 860); I, ordinary leg seta (× 860).

Remarks. In 1912 Berlese (*loc. cit.*) synonymized with Canestrini's *Ottonia distincta* from New Guinea, the species (of which he had been given a specimen) described by Trágårdh, 1904 (Entom. Tidsk., 25, 151, pl. 2, fig. 1–10, 16) from the Cameroons, West Africa, as *Trombidium bipectinatum*. As in all his species, Canestrini's description is brief and inadequate, but Berlese's conclusions appear to have been based on the peculiar hand-like setae on the fourth leg found in the two species.

Canestrini, however, speaks of the dorsal setae as "grani piccoli e grossi spinosi"; in Trägårdh's and Berlese's descriptions and figures, the dorsal setae are shown as being clavate and up to 60μ long, and fusiform to 10μ long. In the new specimen these setae are more of the form of granules (under low power) the larger to 14μ in length and the smaller 8μ. They are thus in agreement with Canestrini's description.

The new specimen is rather smaller than Canestrini's, 1·1 mm. x 0·6 mm. as compared with 3·0 mm. x 1·5 mm., but it is an adult and therefore possibly a male.

As compared with *bipectinatum* the apical portion of the palpal tibia is much shorter and the front tarsi and metatarsi although of approximately the same relative dimensions are much smaller.

The new specimen then seems undoubtedly to be Canestrini's species, which is not the same as Trägårdh's *bipectinatum* from Africa.

In describing a specimen from Buru, Oudemans in Treubia (*loc. cit.*) also shows that Trägärdh's *bipectinatum* from the Cameroons is not the same as *distinctum* of Canestrini from New Guinea, as stated by Berlese (1912). Oudemans' specimen was an old and well developed female and measured 3·777 mm. in length. His details and figures agree well with those given in the above description.

The species described by Boshell and Kerr, 1942, from Columbia under the name of *Microtrombidium arborealis*, but which is here considered a *Camerotrombidium*, has also the peculiar palmate setae on the fourth legs and is therefore closely related to Trägärdh's *bipectinatum* and to *distinctum* of Canestrini.

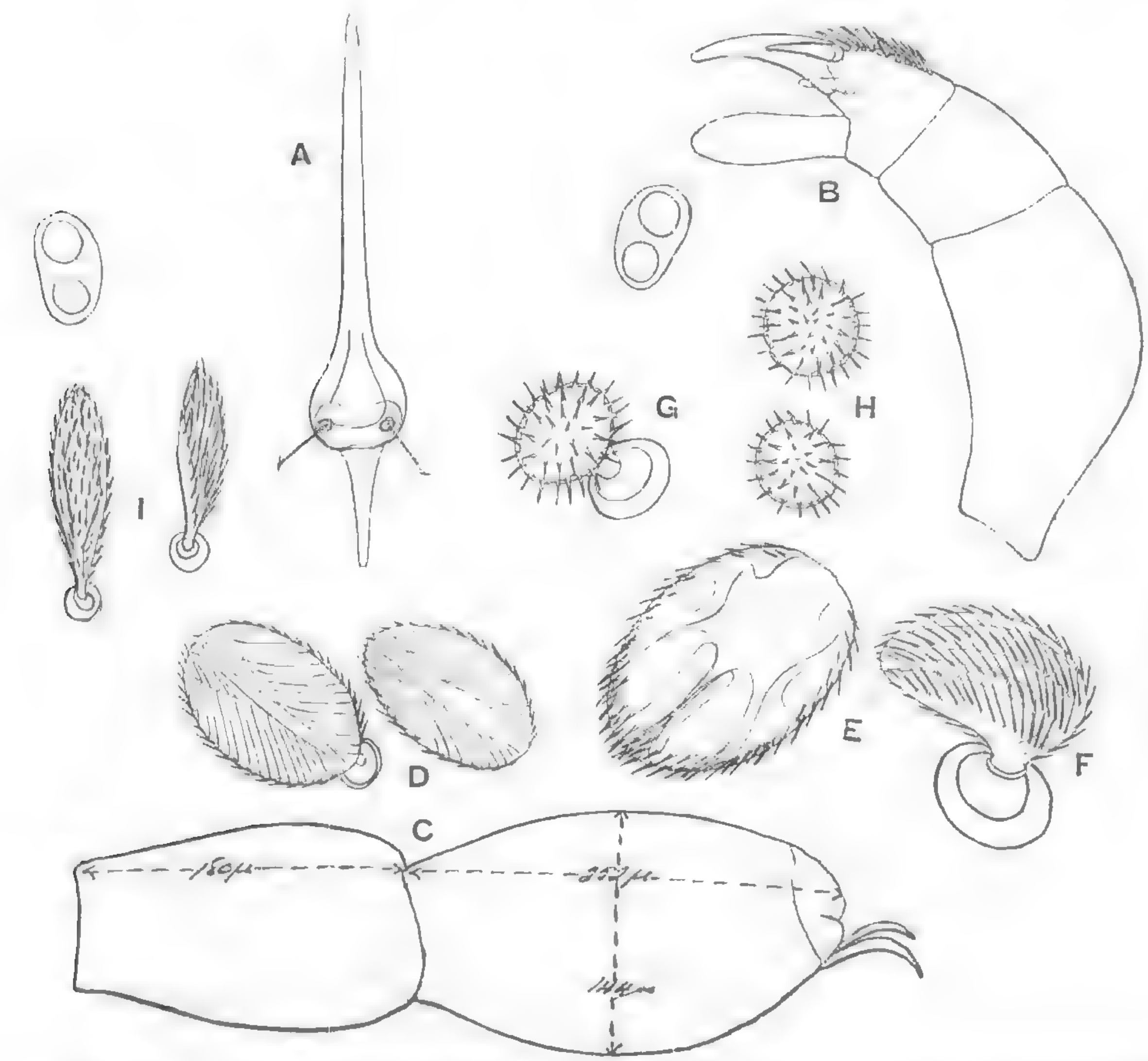

Fig. 37. *Holcotrombidium securigerum* (Canest). A, Crista and eyes (× 200); B, palp (× 200); C, front tarsus and metatarsus (× 200); D, E, F, larger dorsal setae from above, below and side respectively (× 860); G and H, smaller dorsal setae (× 860); I, leg seta (× 860).

Genus HOLCOTROMBIDIUM nov.

Microtrombidiinae in which the dorsal setae are uniform or if of two sizes or forms then the larger ones, decumbent and somewhat scale-like, with their lateral edges curved under to form a channel or helmet-like structure.

Genotype *Ottonia securigera* Canest.

HOLCOTROMBIDIUM SECURIGERUM (Canest.)

Ottonia securigera Canest., 1897. Termes. Fuzet, 463; *idem* 1898 Atti Soc. Veneto-Trentino, 391, pl. 22, fig. 2.

Microtrombidium (Enemothrombium) securigerum Berl., 1912, Redia, 8 (1), 201.

Fig. 27 A–I.

Redescription. Colour in life red. Shape oval with moderately prominent rounded shoulders. Length to 1·5 mm., width to 0·975 mm. Crista linear, 252μ, with subposterior sensillary area at about ⅔ from apex, sensillae ca. 180μ long, filamentous and apparently nude, sensillae bases 40μ apart. Eyes 2+2, sessile, on well developed ocular shields, in advance of sensillary area, posterior the smaller. Palpi as figured, moderately stout, tibia with stout apical and smaller accessory claw,

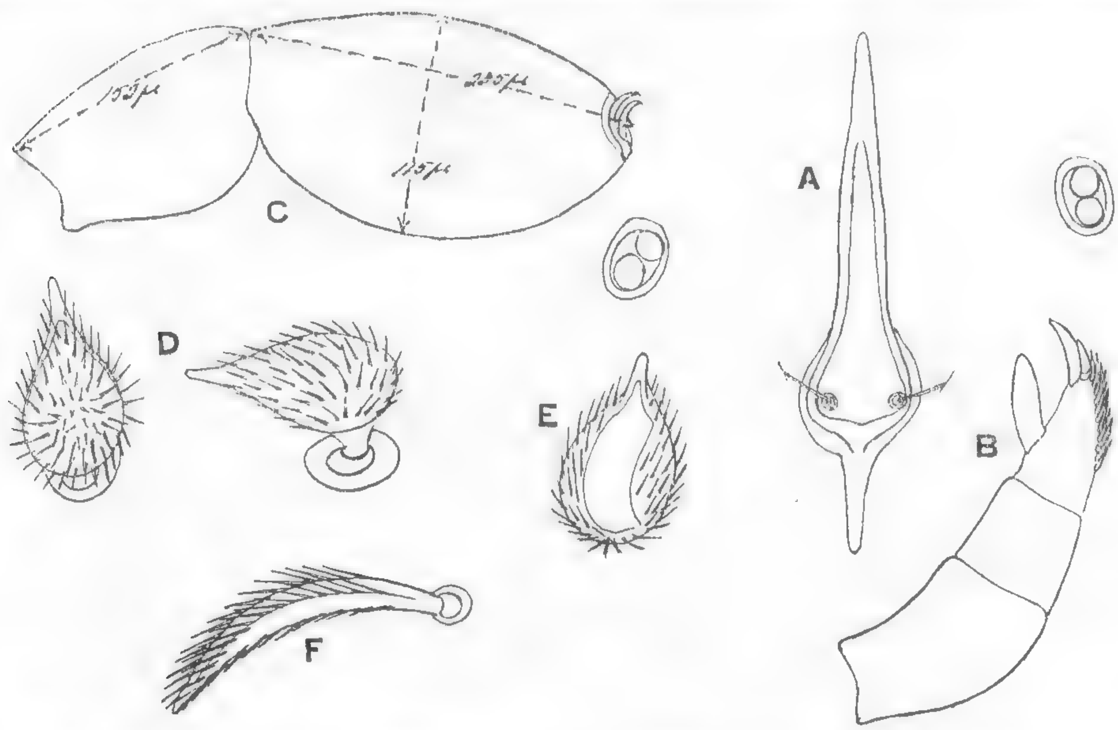

Fig. 28. *Holcotrombidium cygnus* (Wom.). A, Crista and eyes (× 200); B, palp (× 200); C, front tarsus and metatarsus (× 200); D and E, dorsal, lateral and ventral views of dorsal setae (× 860); F, leg seta (× 860).

two pectines and a short stout external spine arising near base of apical claw, tarsus elongate, reaching tip of claw; legs all shorter than body, I 1350μ, II 750μ, III 750μ, IV 975μ; tarsus I elongate, 252μ long by 144μ high, ratio length to height = 1·75, metatarsus I 180μ long, ratio of length tarsus to metatarsus = 1·4. Dorsal setae of two kinds, the larger appearing dorsally as large ovoid, ciliated, decumbent scales, to 30μ long, on edge of body in lateral view appearing somewhat hatchet-shaped, actually, as can be seen from a ventral view, they are really scales in which the sides are turned down to form a cavity like a helmet (cf. fig. 27 D.E.F.); smaller setae 14μ in diam., globose with strong denticles (cf. fig. 27 G.H.). The legs are thickly clothed with more lanceolate ciliated setae, 30μ long, but still showing the recurved lateral margins (cf. fig. 27 I).

Loc. Two specimens from soil, Dobodura area, New Guinea, 3rd May, 1944 (G. M. Kohls).

Remarks. In spite of Canestrini's brief description of this species from Finschhafen, there seems little doubt but that the above two specimens are the same. Of

the dorsal setae Canestrini says "di grani et di squammette discoidali vestite di spine", which appears to agree entirely with the above. The only characters in which there is a slight difference are the front tarsi and metatarsi, of which Canestrini gives the first as twice as long as the second. In the new specimens the ratio is 4 : 3. He also states that the crista is posteriorly bifid, which is doubtful.

HOLCOTROMBIDIUM CYNUS (Womersley, 1936).

Microtrombidium (Enemothrombium) cynus Wom., 1936, Journ. Linn. Soc. London, Zoology, 40 (269), 109, fig. 3 a–c.

Fig. 28 A–F.

A second specimen of this interesting species was collected at Bardon, Queensland, in August, 1943 (N.B.T.).

Comparison with the type from Kangaroo Is., South Australia, shows that they are the same but that the drawings previously given, especially of the dorsal setae are not all that could be desired. Fresh figures derived from the Queensland specimen are therefore given in this paper. The dorsal setae are the shape of a swan's head with a distinct beak and long ciliations (not as previously figured). On careful examination, however, the setae are seen to consist of a thin scale, of which the edges are strongly curved under to form a helmet-like structure with a relatively small opening ventrally. The leg setae are more elongate and foliate but still showing the ventral folding.

HOLCOTROMBIDIUM SCALARIS (Wom., 1936).

Euthrombium scalaris Womersley, 1936, Jour. Linn. Soc., London, Zool., 40 (269), 112, fig. 5 a–c.

Fig. 29 A–F.

This species was described from Auckland, New Zealand, as a doubtful *Euthrombium* for it lacks the posterior dorsal plate. It is now placed in the new genus *Holcotrombidium*.

As there were some slight errors in the original description and the dorsal setae were not sufficiently described the following notes and fresh figures are now given.

The palpal tibia externally carries a slender spine arising from near the base of the palpal tarsus. The front tarsi of the unique type now measure 435μ long by 180μ high, giving a ratio of 2·4, and the metatarsus is 360μ long, giving a ratio of tarsus to metatarsus of 1·2. The dorsal setae are up to 50μ long (not 120μ as previously given) and lie like closely adpressed scales; they are about $\frac{1}{3}$ as wide as long, laminate, with strongly incurved margins but not giving quite such a helmet-like appearance as in the two preceding species; they are dark brown in colour and ciliated on the lateral margins (cf. fig. 29 D). Ventrally the setae are shorter, to 25μ, more hyaline and pointed but still showing the folding; on the legs they are similar, but reaching 40μ in length (cf. fig. 29 E).

HOLCOTROMBIDIUM DENTIPILE (Canest., 1897).

Ottonia dentipilis Canestrini, 1897. Termes. Fuzet., 464.

Microtrombidium (Enemothrombium) dentipile Berl. 1912, Redia, 8 (1), 198.

Fig. 30 A–F.

This species was originally described by Canestrini from Finschhafen, New Guinea and later recorded by Berlese with more details and figures of the palp, front tarsus and metatarsus, dorsal setae and specialized setae from legs from Tijompea and Buitenzorg in Java.

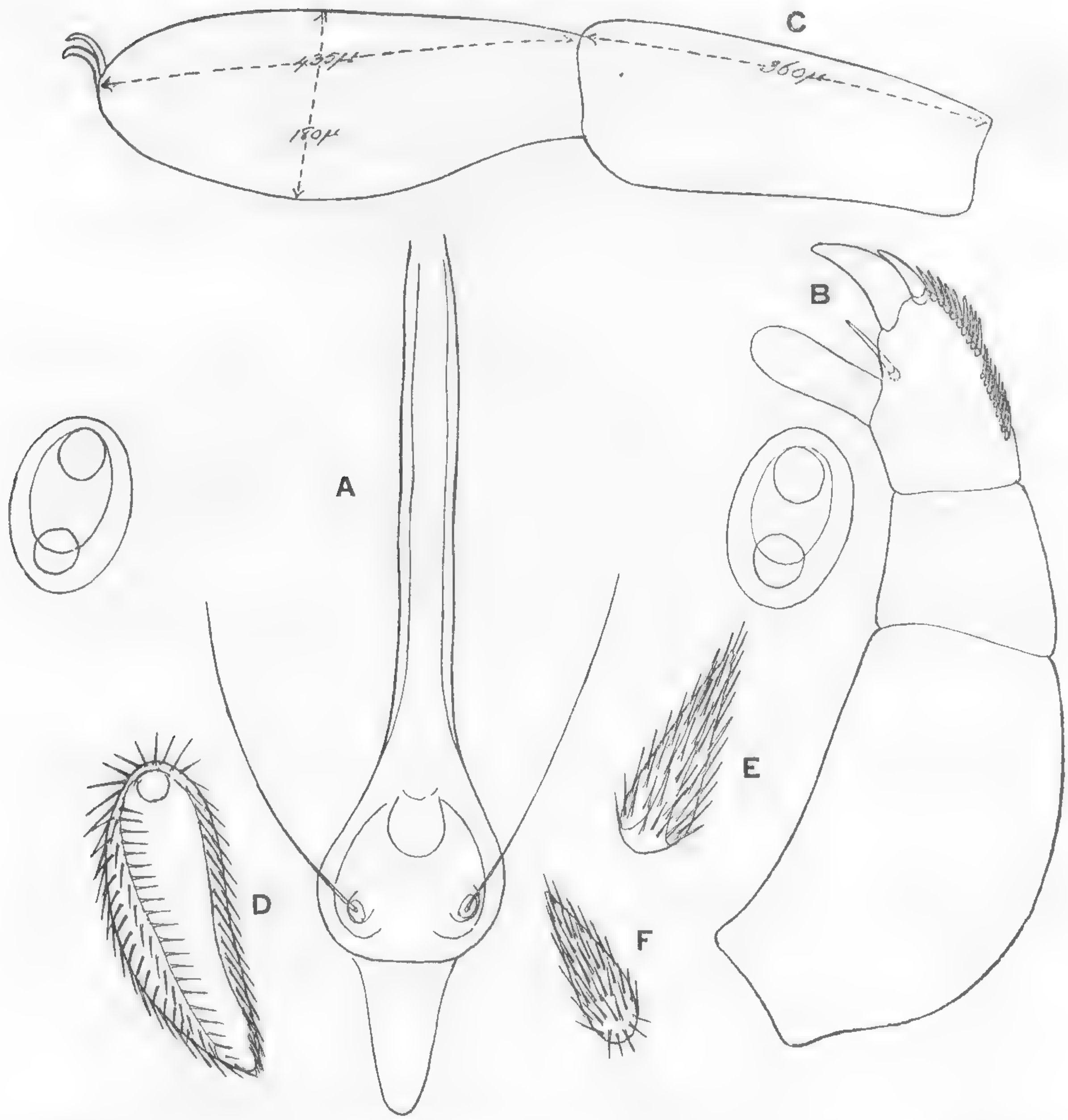

Fig. 29. *Holcotrombidium scalaris* (Wom.). A, Crista and eyes (× 200); B, palp (× 200); C, front tarsus and metatarsus (× 125); D, dorsal seta from below (× 860); E, leg seta (× 860); F, ventral seta (× 860).

I have recently, through the kindness of Sq./Ldr. G. R. Radford, had the privilege of studying two specimens of what must be referred to this species or to a variation of it, from Colombo, Ceylon. The specimens were collected by Sq./Ldr. Radford on 30th Aug., 1944.

The two specimens are both somewhat smaller than the dimensions given by Canestrini and Berlese, namely, 975μ long by 675μ, as compared with 1800μ and 1250μ respectively. The front tarsus is 210μ long by 110μ high, giving a ratio of 1·0 : 1·91, whereas Berlese's figures give a ratio of 1·0 : 2·0, the metatarsus, 146μ long, is rather shorter in proportion to the tarsal length, giving 1·0 :1·17. The dorsal setae are of the two forms as figured by Berlese, although the large decumbent scale-like ciliated setae measure only ca. 35μ, as compared with 60μ given by Berlese. Strictly these setae are not scale-like, but have the lateral margins in-

curved ventrally to give the more or less helmet-like form of the genus *Holcotrombidium*. The smaller setae are as featured by Berlese, with a number of branching granular lobes. Berlese (fig. 82 D–E) shows the specialized comb-like or serrate setae found on segments III onwards of the legs. These are the same on the specimens from Ceylon and measure 35μ long (Berlese does not give the length).

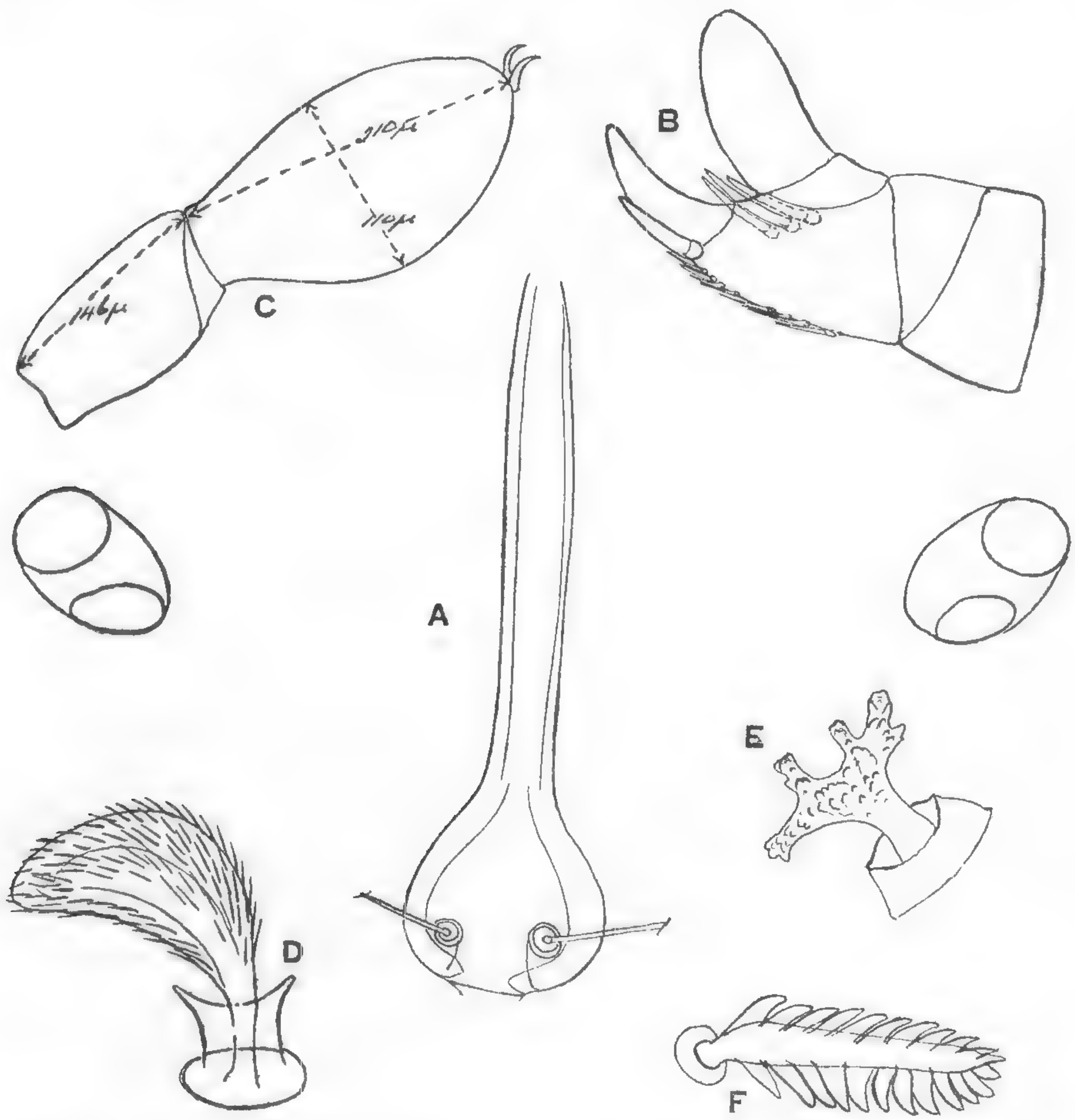

Fig. 30. *Holcotrombidium* cf. *dentipile* (Canest). Specimen from Ceylon. A, Crista and eyes (× 375); B, palp (× 375); C, front tarsus and metatarsus (× 200); D, larger dorsal seta (× 860); E, smaller dorsal seta (× 860); F, leg seta (× 860).

The crista is linear, 200μ long, with a posterior sensillary area, and with SB 30μ apart; the sensillae are filamentous. The palpi are stout, as figured by Berlese, with strong apical tibial claw, strong accessory claw and two indistinct pectines on tibia, and on the external side of tibia with 3 strong long spine-like setae. Berlese states and figures only one such seta but the number of these external spines in some species (e.g. of the genus *Camerotrombidium*) appears to be variable, and consequently while referring the Ceylon material to *dentipile* it should perhaps be considered as a variety. The palpal tarsus is stout, elongate and overreaches tip of tibial claw. The eyes are 2 on each side, prominent and subsessile.

Genus LAMINOTHROMBIUM Wom., 1937.

Rec. S. Aust. Mus., 6 (1), 90. Genotype: *Microtrombidium myrmicum* Wom., 1934.

Dorsal body setae uniform, hyaline, leaf-like and pointed, with strong mid-rib and long marginal ciliations. Palpal tibia with strong apical claw and pectine of few strong teeth. Front tarsus elliptical with height more than half its length.

LAMINOTHROMBIDIUM MYRMICUM (Wom., 1934).

Microtrombidium myrmicum Wom., 1934. Rec. S. Aust. Mus., 5 (2), 189. Fig. 21–23.

Laminothrombium myrmicum Wom., 1937. Rec. S. Aust. Mus., 6 (1), 90.

Although not stated in the original description the palpal tibia of this species has a long, rather slender external spine, arising from near the base of tarsus.

Genus FOLIOTROMBIDIUM nov.

Microtrombidiinae in which some or all of the dorsal setae are thin and laminate, elongate, blunt at apex and the margins not recurved.

Genotype: *Enemothrombium evansi* Wom., 1937.

FOLIOTROMBIDIUM EVANSI (Wom., 1937).

Enemothrombium evansi Womersley, 1937 Rec. S. Aust. Mus., 6 (1), 91, fig. 1 h–j.

Fig. 31 A–D.

Rather small species 1·1 mm. long by 0·7 mm. wide. Colour in life reddish. Crista 245μ, linear, with subposterior sensillary area at about ⅔ from apex, sensillae long and filamentous, with bases 25μ apart. Eyes 2+2, on distinct ocular shields. Palpi with strong apical tibial claw, strong accessory claw, two pectines, but without external spine on tibia. Legs shorter than body, tarsus I broadly elliptical, 209μ long by 137μ high, metatarsus I 120μ long. Dorsal setae uniform, elongate, laminate, broadly rounded apically and with longitudinal rows of short strong spinules, 24–32μ long (cf. fig. 31 D).

Loc. Only known from the type from Mt. Wellington, Tas., May, 1935 (J.W.E.).

Remarks. The other two specimens from Queensland and Victoria referred to this species in my original publication (*loc. cit.*) are not co-specific and are herewith described as a new species.

The dimensions of the crista and front tarsi and metatarsi in the original description are somewhat inaccurate.

FOLIOTROMBIDIUM BISETOSUM sp. nov.

Fig. 31 E–H.

Description. Adult. Length to 1·35 mm., width to 0·85 mm. Shape elongate oval, broadest across shoulders. Colour in life red. As mounted division line between propodosoma and hysterosoma indistinct. Crista 218μ long, linear, with subposterior sensillary area at about ⅔ from apex. Sensillae long and 25μ apart. Eyes small, 2+2, on distinct ocular shields. Palpi stout, tibia with strong apical claw, smaller accessory claw and two pectines, but no external spine: tarsus elongate but not reaching tip of tibial claw. Legs all shorter than body, I 750μ,

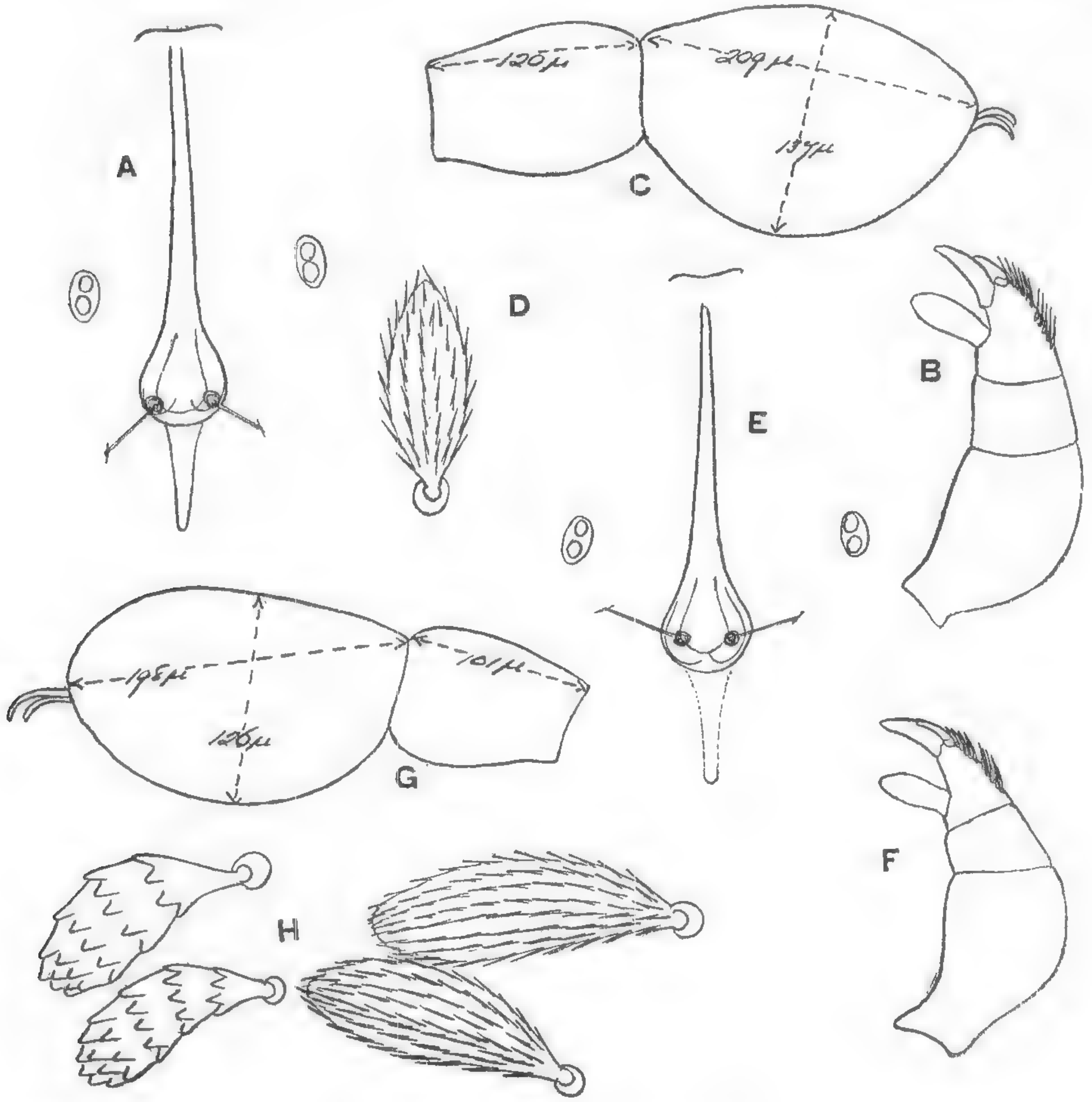

Fig. 31. A–D. *Foliotrombidium evansi* (Wom.). A, Crista and eyes (× 200); B, palp (× 200); C, front tarsus and metatarsus (× 200); D, dorsal seta (× 860). E–H. *Foliotrombidium bisetosum* sp. n. E, Crista and eyes (× 200); F, palp (× 200); G, front tarsus and metatarsus (× 200); H, dorsal setae (× 860).

II 510μ, III 510μ, IV 870μ, tarsus I 198μ long by 120μ high, metatarsus I 101μ long. Dorsal setae of two kinds, the longer elongate and lamellate, with rounded apex and longitudinal rows of strong short spinules or ciliations, to 40μ long; shorter slightly curved, not so lamellate, and with strong rounded nodules (cf. fig. 31 H).

Loc. Type and paratype from moss, Brisbane, Queensland, Oct., 1934. Another specimen from Fern Tree Gully, Victoria, Jan., 1937 (H.W.).

FOLIOTROMBIDIUM ORNATUM sp. nov.

Fig. 32 A–D.

Description. Adult. Length 1·2 mm., width 0·6 mm. Shape an elongate oval, broadest across the shoulders which are well rounded but not prominent. Colour in life red. Crista linear, 272μ long, with subposterior sensillary area at about ⅔ from apex, sensillae long and filamentous, apparently nude, with bases

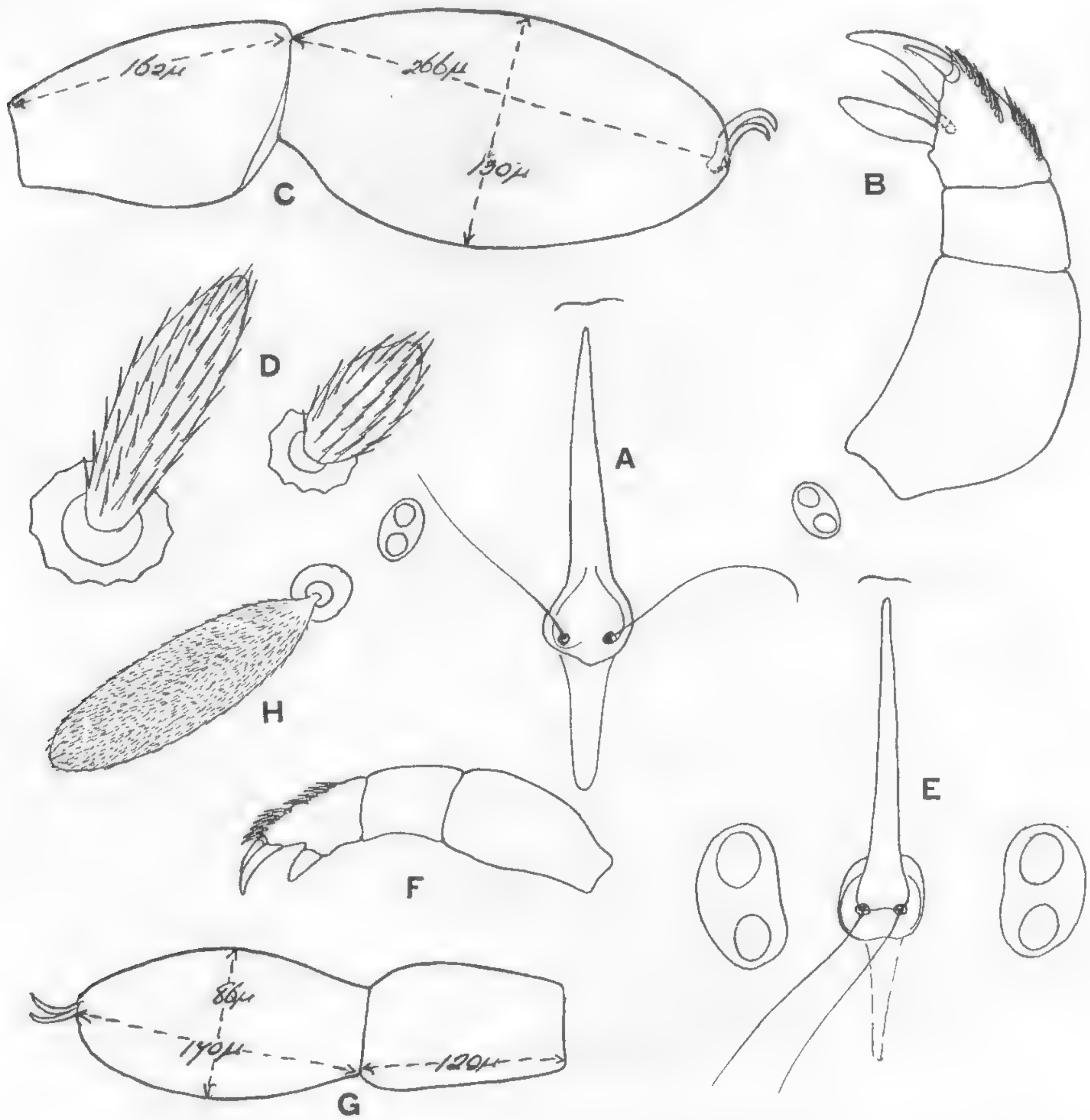

Fig. 32. A–D. *Foliotrombidium ornatum* sp. n. A, Crista and eyes (× 200); B, palp (× 200); C, front tarsus and metatarsus (× 200); D, dorsal setae (× 860). E–H. *Foliotrombidium kohlsi* sp. n. E, Crista and eyes (× 200); F, palp (× 200); G, front tarsus and metatarsus (× 200); H, dorsal setae (× 860).

30μ apart. Eyes 2+2, on well defined ocular shields. Palpi stout, tibia with strong apical claw, smaller accessory claw, two pectines and a long slender external spine from near base of tarsus; tarsus elongate, but not reaching tip of claw. Legs not longer than body, I thicker than others, 1050μ long, II 675μ, III 675μ, IV 1020μ; tarsus I elongate oval, 266μ long by 130μ high, metatarsus I 162μ long. Dorsal setae uniformly of the same form but varying in length from 20μ to 40μ, laminate, with rounded apex, with longitudinal rows of spinules, width ca. 10μ, arising from short peduncles.

Loc. A single adult specimen from Belair, S. Australia, 29th May, 1938 (H.W.).

Remarks. Can be distinguished as in the following key.

FOLIOTROMBIDIUM KOHLSI sp. nov.

Fig. 32 E–H.

Description. Adult. Length 1·5 mm., width 0·9 mm. Shape elongate oval, broadest across the moderately prominent shoulders. Suture between propodosoma and hysterosoma distinct. Colour red. Crista linear, 182μ long with subposterior sensillary area at about ⅔ from apex, posterior arm almost obsolescent, sensillae long and filamentous, apparently nude, and with their bases 25μ apart. Eyes large, 2+2, on well defined ocular shields, and in line with sensillary area, sessile. Palpi as in fig. 32 F, tibia with strong apical claw and accessory claw, two pectines, but no external spine; tarsus short and stumpy, only just passing base of large tibial claw. Legs all shorter than body, I 825μ, II 510μ, III 570μ, IV 690μ; tarsus I elongate, 170μ long by 80μ high, metatarsus 120μ long. Dorsal setae uniform consisting of very thin laminae, 40μ by 10μ wide, with rounded apex and furnished with very short fine pubescence; similar setae extend on to legs as far as the tarsi; and on to the femur of the palpi.

Loc. A single specimen from soil, Goodenough Is., New Guinea, 17th Jan., 1944 (G. M. Kohls). A second specimen from the same locality, 31st Dec., 1943 (D.C.S.).

Remarks. Distinguished as in the key.

KEY TO THE ABOVE SPECIES OF *Foliotrombidium*.

1. Front tarsus ca. 1½ times as long as high .. .. 2.
   Front tarsus ca. twice as long as high .. .. 3.
2. Dorsal setae uniform, of one type (cf. fig. 31 D) .. .. .. *evansi* Wom.
   Dorsal setae of two types (cf. fig. 31 H) .. .. .. *bisetosum* n.sp.
3. Dorsal setae uniform, very thinly laminate with fine pubescence. Palpal tibia without external spine. Eyes large and in line with sensillary area . .. *kohlsi* n.sp.
   Dorsal setae of varying size, but the one type, not thinly laminate, furnished with strong setules. Palpal tibia with a long slender external spine. Eyes smaller and in advance of sensillary area .. .. *ornatum* n.sp.

Genus HIOTROMBIDIUM nov.

Microtrombidiinae in which the dorsal setae are mainly or entirely bifurcate from the base, and consist of two opposed curved ciliated lamellae, forming a pair of lips; the lamellae may be entire or secondarily divided.

Genotype: *Calothrombium tubbi* Wom., 1937.

HIOTROMBIDIUM TUBBI (Wom., 1937).

Calothrombium tubbi Womersley, 1937, Rec. S. Aust. Mus., 6 (1), 86. Fig. 1 a–d; *ibid.* 1942, Rec. S. Aust. Mus., 7 (2), fig. 5 E–H.

Fig. 33 A–F.

The palpal tibia has a strong slender external spine (not shown in the original figure) arising from between base of claw and base of tarsus. The dorsal setae are uniform on the hysterosoma, 24μ long, with the upper lamella strongly curved and broad (cf. fig. 33 D and E) and the lower lamella straight, more or less tapering and not so broad, but with long spinules. Along the crista, the setae are of similar form, to 45μ long, with the upper lamella not so curved and apparently not so broad (cf. fig. 33 F). Anterolaterally on the propodosoma, the setae are

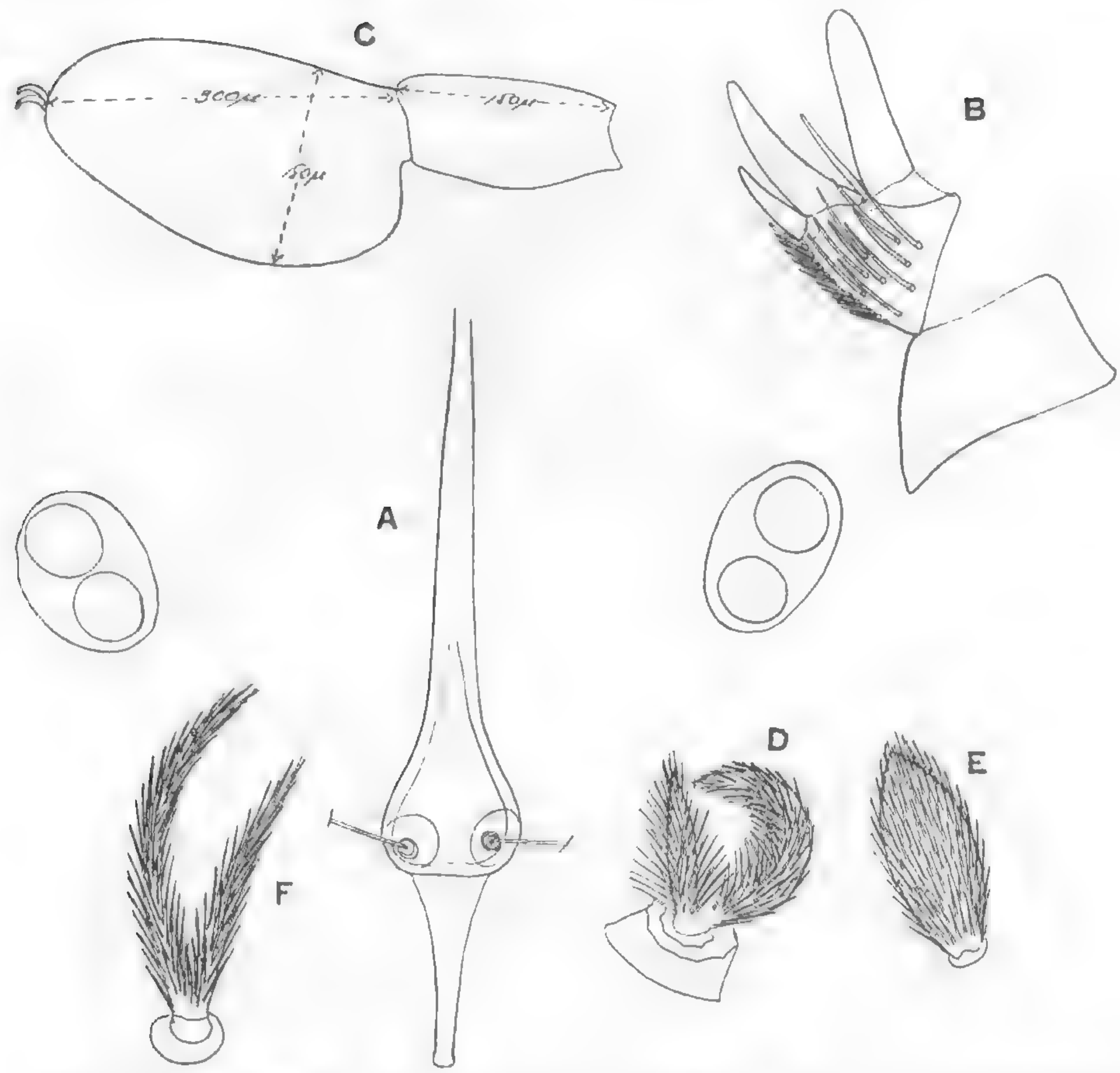

Fig. 33. *Hiotrombidium tubbi* (Wom.). A, Crista and eyes (× 200); B, palpal tibia (× 200); C, front tarsus and metatarsus (× 125); D, dorsal setae from side (× 860); E, same from above (× 860); F, dorsal seta from propodosoma (× 860).

simple, elongate, pointed and ciliated, with a few of them forked distally. The leg setae are simple, ciliated and more or less curved. The sensillae long and filamentous, with bases 40μ apart.

Loc. Only known from the original specimen from Heathmont, Vic., 28th July, 1934 (H. Tubb).

HIOTROMBIDIUM HEASLIPI (Wom., 1942).

Calothrombium heaslipi Womersley, 1942, Rec. S. Aust. Mus., 7 (2), 174. Fig. 5 A–D.

Fig. 34 A–D.

This species in the form and size of the dorsal hysterosomal setae is very close to the preceding; these setae are, however, somewhat smaller and the forked structure not so easy to see. Along the crista, along the suture between propodosoma and hystrosoma and anterolaterally on the propodosoma, some of the setae are apparently simple, broadly elongate and ciliated, with rounded apex; otherwise the setae are as on the rest of the dorsum. The palpal tibia has a long slender external spine (not shown in earlier figure). Crista linear, 290μ long,

with subposterior sensillary area; sensillae long and filamentous, with bases 36μ apart.

Loc. Still only known from the original specimens from Cairns, Queensland, 1939 (W.G.H.).

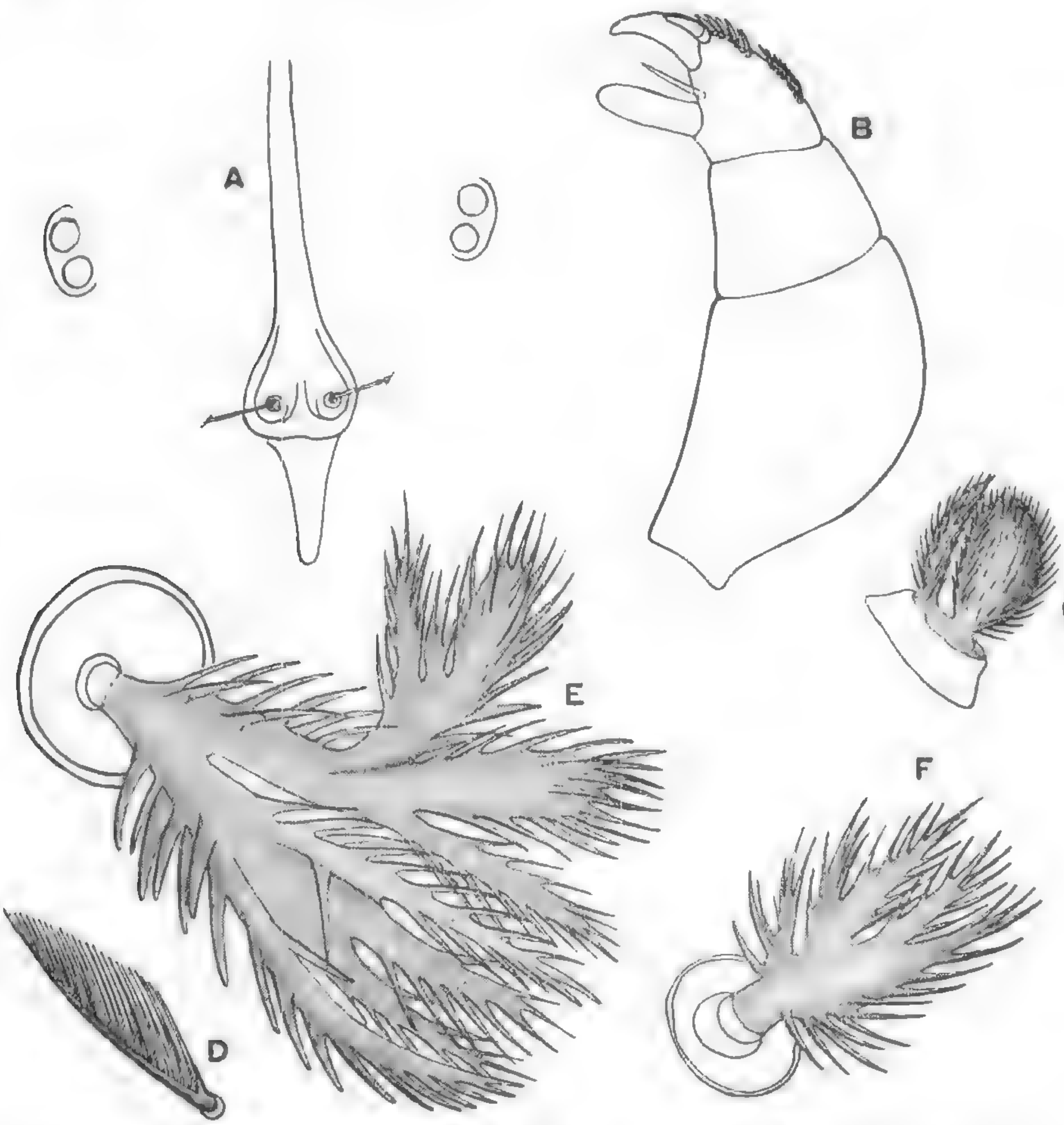

Fig. 34. A–D. *Hiotrombidium heaslipi* (Wom.). A, Crista and eeys (× 200); B, palp (× 200); C, front tarsus and metatarsus (× 200); D, dorsal seta (× 860). E–F. *Hiotrombidium koordanum* (Hirst). E, Larger dorsal seta (× 860); F, smaller dorsal seta (× 860).

HIOTROMBIDIUM KOORDANUM (Hirst, 1938).

Microtrombidium koordanum Hirst, 1928. P.Z.S. 1023 fig. 2 B.E.

M. (Enemothrombium) koordanum Womersley 1934. Rec. S. Aust. Mus., 5 (2), 195.

Calothrombium koordanum Womersley, 1937 *ibid.*, 6 (1), 85.

Fig. 34 E–F.

The dorsal setae of this species are approximately of two sizes, in which the larger, to 80μ long, consist essentially of two lamellae which are themselves second-

arily forked, but they form opposing convex lobes as in the preceding species; they are furnished with long and strong spinules. The smaller setae to 40μ long, appear to be simple although forked (cf. fig. 34 F).

HIOTROMBIDIUM CANBERRAENSE sp. nov.

Fig. 35 A–I.

Description. Adult. Colour in life red. Shape somewhat elongate oval, broadest across the shoulders. Length 1·725 mm . width 1·05 mm. Legs shorter than body. Crista linear, 345μ, with subposterior sensillary area, SB 36μ apart. Sen-

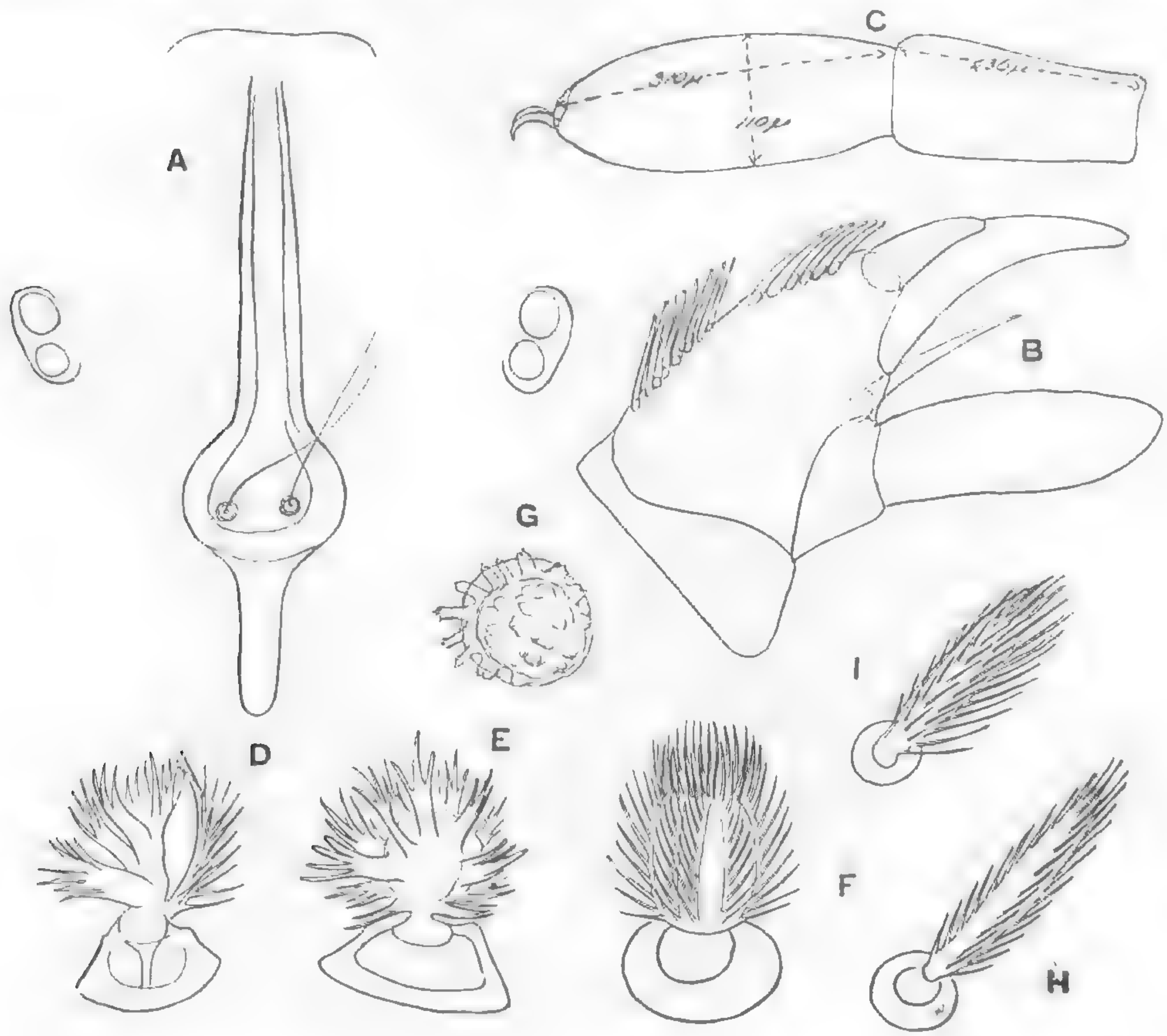

Fig. 35. *Hiotrombidium canberraensis* sp. n. A, Crista and eyes (× 200); B, palpal tibia (× 375); C, front tarsus and metatarsus (× 125); D, E, F, G, different views of dorsal setae (× 860); H, dorsal seta from near suture (× 860); I, leg seta (× 860).

sillae filamentous, ca. 150μ long. Eyes 2+2, on distinct subsessile ocular shields. Palpi stout, tibia with stout apical claw, and smaller stout accessory claw, two pectines and a single long, pointed, external spine arising from near base of tarsus: tarsus elongate, reaching tip of tibial claw. Length of legs, I, 1350μ, II 960μ, III 750μ, IV 1275μ; tarsus I 310μ long by 110μ high, metatarsus I 236μ long.

Dorsal setae short, 27μ, uniform, bifurcate from base as in fig. 35 D–G; although this is only seen with difficulty, the upper branch is subdivided as in

Fig. 35 D-G, the lower with longitudinal rows of long setae; near the suture and base of crista are some long, 36μ, elongate, simple, ciliated setae as in Fig. 35 H; the legs are thickly covered with setae as in Fig. 35 I, to 30μ long.

Loc. A single specimen found under a stone on Black Mt., Canberra, A.C.T., 19th Oct., 1944 (H.W.).

The above four species may be separated by the following key.

1. One or both lamellae of dorsal setae secondarily branched .. .. .. 2.
   Both lamellae of dorsal setae not branched .. .. 3.
2. Large species to ca. 5·0 mm. Both lamellae of dorsal setae strongly branched. Front tarsus and metatarsus equal, 660μ long; tarsi highest on apical fourth, 330μ
   koordanum (Hirst, 1928).
   Smaller species, under 2·0 mm. Upper lamella of dorsal setae only, subdivided. Front tarsus distinctly longer than metatarsus, 310μ long by 110μ high .. *canberraensis* n.sp.
3. Setae along crista similar to on dorsum but longer; some setae on antero-lateral area of propodosoma simple, elongate and tapering, sometimes distally forked, to 30μ long
   tubbi (Wom. 1937).
   Setae along suture between propodosoma and hysterosoma, antero-laterally on propodosoma and more or less along crista, broadly elongate and blunt at apex, to 45μ long
   heaslipi (Wom. 1942).

The three previously described species were earlier placed in the genus *Calothrombium*, largely on the forked dorsal seta as figured by Berlese for *Calothrombium paoli* Berl., the type of this genus. *Calothrombium*, however, in the structure of the crista, and the absence of a distinct sensillary areola-like area, and the position of the sensillae bases, is much more closely related to *Tanaupodus* Haller and should be placed in the subfamily Tanaupodinae Sig Thor, 1935. The above species are definitely belonging to the Microtrombidiinae.

Genus PEDOTROMBIDIUM nov.

Form elongate oval as in *Eutrombidium* but without nasus or posterior dorsal plate. Crista linear with subposterior sensillary area. Legs I to III much shorter than body; IV about as long as body, stronger than the others, with its coxae very elongate and attached to coxae III almost at right angles. I and IV with some of middle segments produced laterally at tip on each side. Eyes 2+2 sessile, not on ocular shields. Dorsal setae uniform dorsally and ventrally, fusiform, on short tubules. Palpi with tibial claw and accessory claw.

Genotype: *Pedotrombidium kohlsi* n.sp.

PEDOTROMBIDIUM KOHLSI sp. nov.

Fig. 36 A–F.

Description. Shape an elongate oval, without prominent shoulders, rather tapering posteriorly, hysterosoma widest medially somewhat in front of coxae III; propodosoma triangular, without nasus, narrower basally than hysterosoma. Length to 0·915 mm., width to 0·45 mm. Crista linear, 165μ long, with subposterior sensillary area at about ⅔ from tip, sensillary bases 21μ apart, sensillae filamentous ca. 130μ long, and apparently nude. Eyes 2+2, small and placed close to lateral margin of propodosoma, not greatly in front of sensillary area, sessile, not on ocular shields. Legs, except IV much shorter than body, I 600μ, II 420μ, III 450μ, IV 825μ, IV much stronger than others, its coxae longitudinally elongate and attached almost at right angles to coxae III; tarsus I elongate, 170μ long by 72μ high giving a ratio of 2·36; metatarsus I 108μ long giving ratio of length of tarsus to metatarsus of 1·57. Leg I on segments 5 and 6 and IV on segments 4–6 produced laterally on each side at tip in irregular teeth (cf. fig. 36 G, H). Palpi not very stout, tibia with strong apical and accessory claw, two pectines but no external spines; tarsus elongate, slightly exceeding tip of claw.

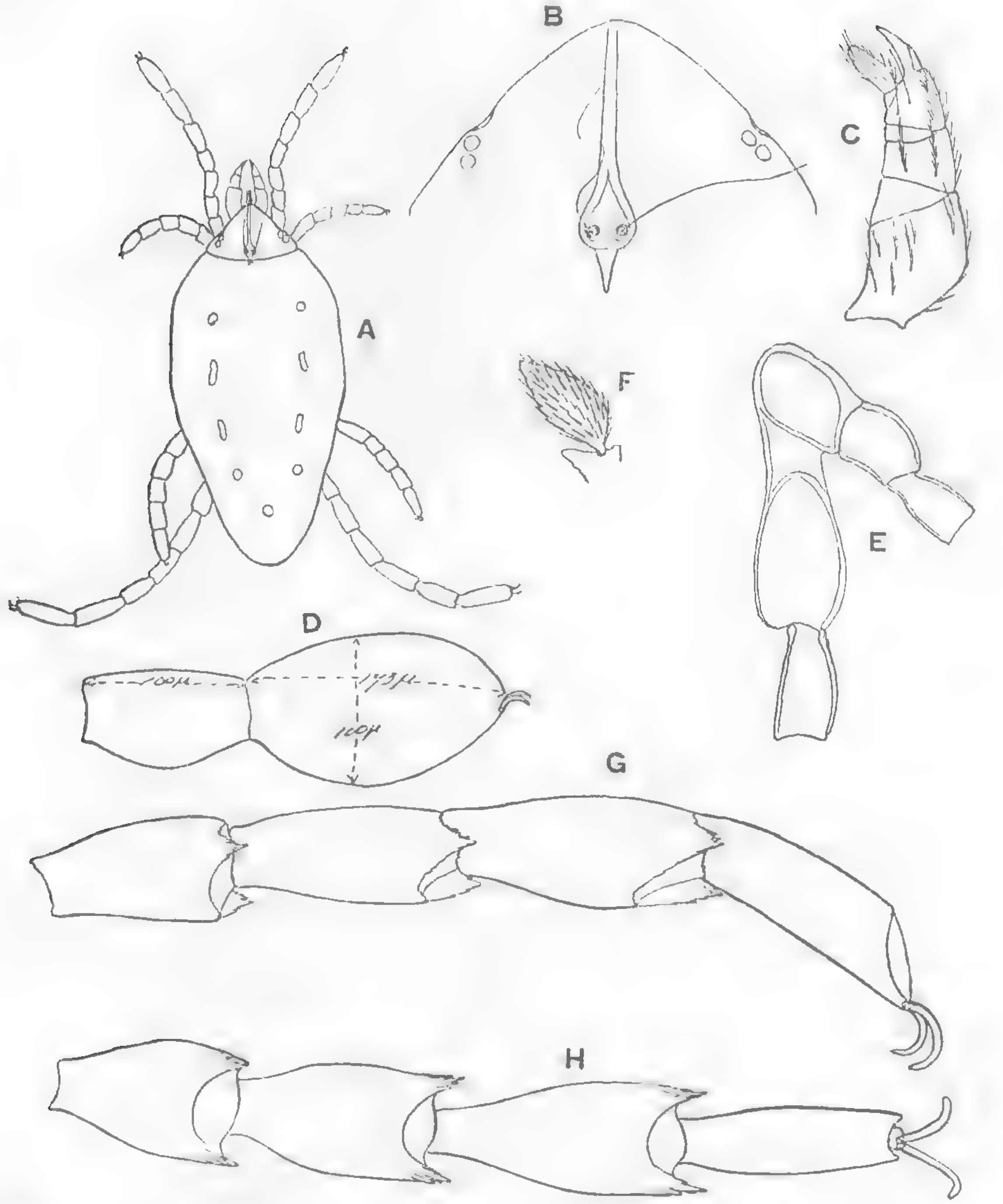

Fig. 36. *Pedotrombidium kohlsi* sp. n. A, Entire dorsal view; B, front of propodosoma showing crista and eyes (× 200); C, palp (× 200); D, front tarsus and metatarsus (× 200); E, coxae III and IV; F, dorsal seta (× 860); G, leg IV, distal segments from side (× 200); H, same from below (× 200).

Clothing both dorsally and ventrally uniform, 16–18μ, fusiform, conical, pointed, ciliated setae arising from distinct pedicels; near the margins of propodosoma they become a little more elongate. On the hysterosoma a series of 9 chitinized, hexagonally patterned, muscle spots are observable.

Loc. Some half-dozen specimens of this very interesting species were collected from soil in New Guinea, 1943, by Maj. Glen M. Kohls, after whom I have much pleasure in naming it.

Genus PLATYTROMBIDIUM Sig Thor, 1936.

Zool. Anz. 1936, 114, 31.

This genus was erected by Sig Thor for those species, placed by Berlese in the genus *Enemothrombium*, in which the dorsal setae were fusiform with fine ciliations. He cited *Trombidium vagabundum* Berl., 1903 as the genotype, and included the following additional species: *fusicoma* (Berl., 1910); *sylvaticum* (C. L. Koch, 1835) (= *simulans* (Berl., 1910)); *trispinum* (Berl., 1910); *quadrispinum* (Berl., 1910); and *platychirum* (Berl., 1910) In 1937 I added Hirst's South Australian species *paranum*.

PLATYTROMBIDIUM PARANUM (Hirst, 1928).

Microtrombidium paranum Hirst, 1928, P.Z.S. 1026, fig. 3 B.E; Womersley, 1934. Rec. S. Aust. Mus., 5 (2), 191.

Platytrombidium paranum Womersley, 1937. Rec. S. Aust. Mus., 6 (1), 90.

Fig. 37 A–D.

Redescription. Colour bright red. Shape as in the species of *Camerotrombidium*, with the usual sulcus between propodosoma and hysterosoma. Length to 1·5 mm. approx., width to 1·0 mm. approx. across shoulders (in type ca. 1·25 mm. and ?). Crista to 342μ long (missing in type), linear, with subposterior sensillary area at about ⅔ from anterior end, sensillae bases 32μ apart, sensillae ca. 150μ long, with short sparse ciliations distally. Eyes 2+2, on well defined ocular shields. Legs shorter than body, I 1125μ (975μ), II 900μ (875μ), III 900μ (840μ), IV 1290μ (1050μ); tarsus I short and broad, 225μ long by 135μ high = ratio of 1·7, metatarsus I 165μ long, ratio of length of tarsus I to metatarsus I = 1·36. Palpi stout, tibia with stout apical claw and smaller accessory claw, two pectines and on external side with a stout strong spine arising near base of tarsus (Hirst does not show this in his figure, but it is present in the type, as well as in the second specimen); palpal tarsus elongate, about reaching tip of claw.

Clothing of uniform, small, 16–25μ, fusiform, oval, pointed, finely ciliated setae; these setae gradually lengthen posteriorly and also anteriorly and laterally on the propodosoma; at the apex of propodosoma in front of tip of crista is a fringe of long slender ciliated setae; ventrally the setae are to 30μ in length, slender and tapering with ciliations, legs and palpi without any specialized setae.

Loc. The type material (damaged) was from Gawler, S. Aust., March, 1927 (S.H.), (in the S. Aust. Mus. collection): a second specimen from Bordertown, South Australia, Dec., 1934 (R.V.S.)

Remarks. The above description is drawn up from both specimens. The measurements given in parentheses refer to the type, and are only shown when the specimens differ.

PLATYTROMBIDIUM PRITCHARDI (Wom., 1936).

Microtrombidium pritchardi Womersley, 1936. J. Linn. Soc., London, Zool., 40, 109, fig. 2 a–e.

Fig. 38 A–D.

There is little to add to my original description of this species. A paratype specimen from the same locality and date is somewhat smaller than the type. Its dimensions are: length 1·35 mm., width 0·9 mm. Leg I 945μ, II 680μ, III 650μ, IV 900μ; tarsus I 195μ long by 90μ high, metatarsus 135μ long.

In my remarks (*loc. cit.*) it was stated that the species was close to *P. fusicomum* (Berl.), cited by Sig Thor as the genotype, and that it mainly differed in the dimensions of the front tarsi and metatarsi. For *fusicomum* Berlese gives the tarsus as 190μ long by 110μ high and the metatarsus I as 113μ long, giving the following ratios, tarsus length : tarsus height = 1·73, tarsus length : metatarsus

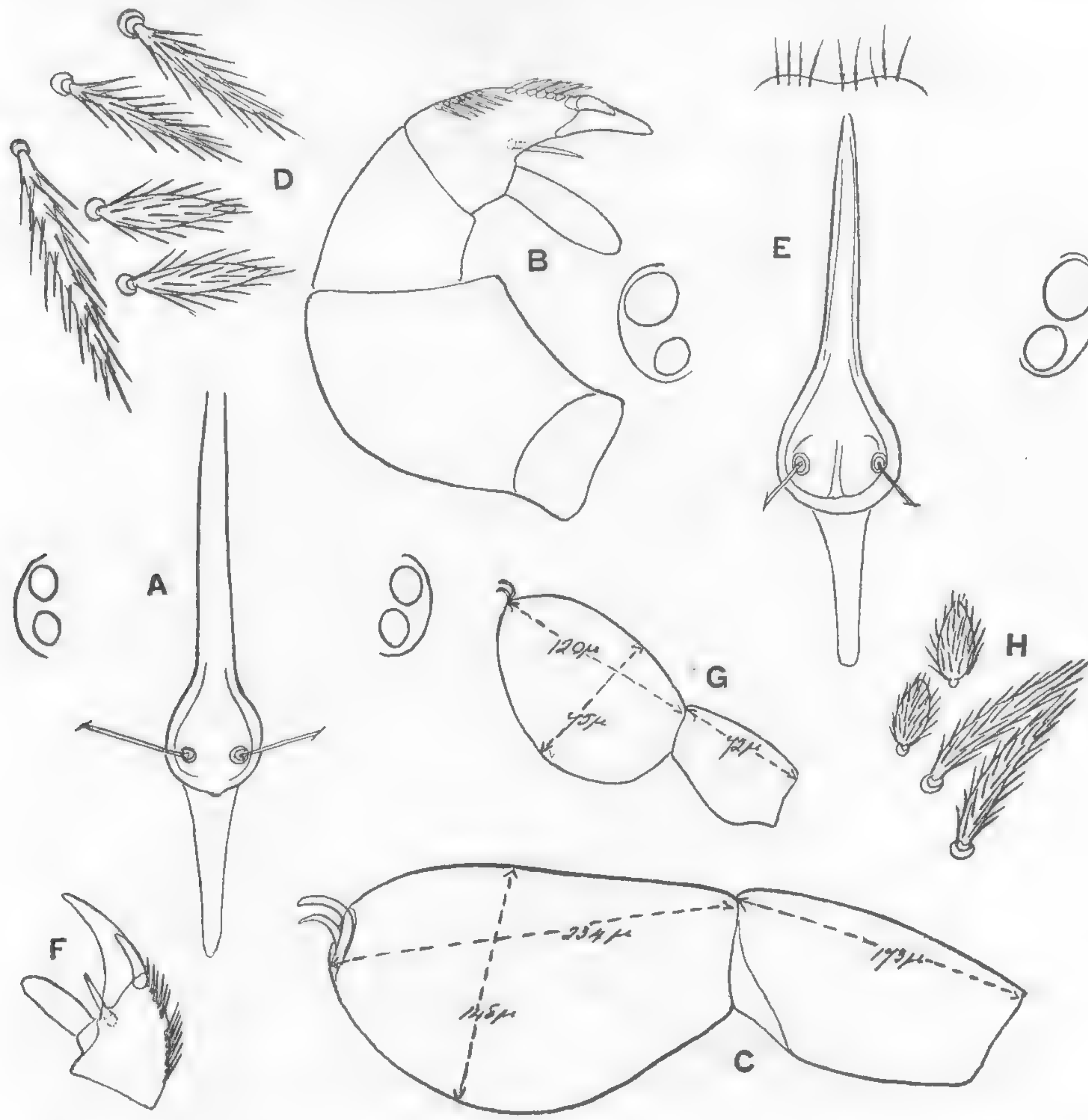

Fig. 37. A–D. *Platytrombidium paranum* (Hirst). A, Crista and eyes (× 200); B, palp (× 200); C, front tarsus and metatarsus (× 200); D, dorsal setae (× 860). E–H. *Platytrombidium fusciforme* sp. n. E, Crista and eyes (× 200); F, palpal tibia (× 200); G, front tarsus and metatarsus (× 200); H, dorsal setae (× 860).

length = 1·6. In *pritchardi* the tarsus and metatarsus are relatively longer and give the following ratios 2·17 (2·1) and 1·44 (1·5) respectively (the type figures in parenthesis). The ventral setae are similar in size and form to those on the dorsum.

Loc. Two specimens from Davis's bush, Manurewa, New Zealand, May, 1934 (E.D.P.).

PLATYTROMBIDIUM FUSCIFORME sp. nov.

Fig. 37 E–H.

Description. Adult. Small red species of cordate shape. Length 0·72 mm., width 0·42 mm. Legs shorter than body, I 510μ, II 320μ, III 330μ, IV 480μ; tarsus I roughly elliptical but highest near the base, 120μ long by 75μ high, metatarsus 72μ long. Crista linear, 150μ long, with subposterior sensillary area and paired filamentous sensillae with their bases 21μ apart. Eyes relatively large,

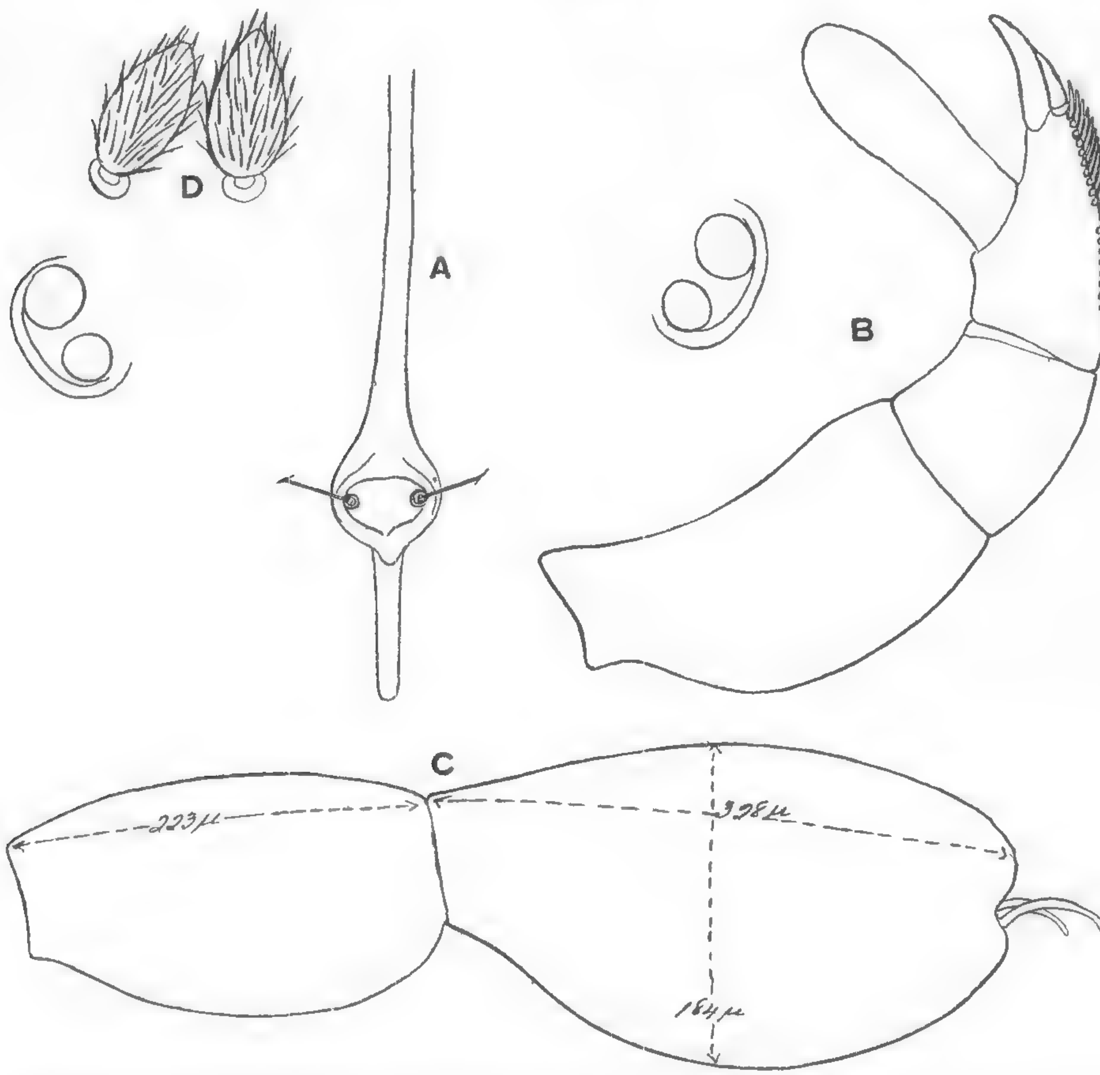

Fig. 38. *Platytrombidium pritchardi* (Wom.). A, Crista and eyes (× 200); B, palp (× 200); C, front tarsus and metatarsus (× 200); D, dorsal setae (× 860).

2+2, sessile, on distinct ocular shields. Palpal tibia stout as figured, tibia with a slender fairly stout external spine, two pectines, strong apical claw and smaller accessory claw. Inner edge of chelicerae finely serrate. Dorsal setae of two forms and sizes; on the disc short, pointed, ovate and fusiform, to 12μ with long setules, on sides and posterior end to 20μ long, fairly thick, not ovate, with long setules, these longer setae also occur about the crista and suture.

Loc. Nine specimens from soil, Dobodura area of New Guinea, about July, 1944 (G. M. Kohls).

Remarks. Easily distinguished from the other two species by the dimensions of the front tarsi and metatarsi and the dorsal setae.

SUMMARY.

The subfamily Microtrombidiinae of the Trombidiidae, of Australia and New Guinea, is revised. The subfamily is restricted to those species in which the palpal tibiae are furnished with a strong apical claw, a smaller but stout accessory claw (absent in one species of *Dromeothrombium*), two pectines and with or without an external spine; the crista is linear with a subposterior sensillary area, but without any anterior expanded nasus-like area. Sixteen adult genera are now recognized, the characters lying in the different distinct structural groups into which the dorsal setae can be arranged, thus following the initial generic classifications of Berlese and Sig Thor. Of these 16 genera, eleven, of which five are new, are recognized from Australia, New Guinea and New Zealand. Twenty-three new species are described, one as a variety of a European species. *M. spinatum* and *M. tubbi* are sunk as synonyms. Four of Canestrini's New Guinea species *furcipile, distinctum, securigerum* and *dentipile* have been rediscovered and are redescribed. *Distinctum* Canst. is shown not to be synonymous with *bipectinatum* Trägårdh from the Cameroons as stated by Berlese, 1912. The larva of a species of *Camerotrombidium* is described. The genera *Neotrombidium* Leonardi and *Calothrombium* Berl. placed by Sig Thor and others in this subfamily are removed.

The genera and species recorded are as follows:

Dromeothrombium queenslandiae nom. nov. for *macropodum* Wom. *nec* Berl. Queensland.
Echinothrombium echidninum (Hirst) South Australia.
Echinothrombium willungae (Hirst) South Australia.
Echinothrombium bardonense sp. nov. Queensland.
Echinothrombium lamingtonense sp. nov. Queensland.
Spathulathrombium southcotti (Wom.) gen. nov. South Australia.
Spathulathrombium maximum sp. nov. Tasmania.
Spathulathrombium queenslandiae sp. nov. Queensland.
Spathulathrombium fulgidum sp. nov. South Australia.
Spathulathrombium myloriense sp. nov. South Australia.
Microtrombidium zelandicum Wom. New Zealand.
Microtrombidium maculatum Wom. Victoria.
Microtrombidium karriensis Wom. South Australia, Tasmania.
Microtrombidium hirsutum sp. nov. S. Australia.
Microtrombidium wellingtonense sp. nov. Tasmania.
Microtrombidium papuanum sp. nov. New Guinea.
Microtrombidium myloriense sp. nov. South Australia.
Microtrombidium cf. *furcipile* (Canest.) New Guinea.
Microtrombidium aequalis (Banks) Western Australia and South Australia.
Microtrombidium affine Hirst Western Australia and South Australia.
Microtrombidium newmani Wom. Western Australia.
Microtrombidium adelaidicum Wom. South Australia, New South Wales and Queensland.
Microtrombidium jabanicum Berl. New Guinea.
Microtrombidium goodenoughensis sp. nov. New Guinea.
Microtrombidium cordatum sp. nov. New Guinea.
Camerotrombidium simile (Hirst). South Australia, New South Wales (adult, and larvae).
Camerotrombidium collinum (Hirst) South Australia.
Camerotrombidium wyandrae (Hirst). Queensland.
Camerotrombidium opulentum sp. nov. South Australia.
Camerotrombidium vaginatum sp. nov. South Australia.
Camerotrombidium carduum sp. nov. Western Australia.
Camerotrombidium rasum v. *robensis* nov. South Australia.
Camerotrombidium distinctum (Canest). New Guinea.

Holcotrombidium securigerum (Canest) gen. nov. New Guinea.
Holcotrombidium cygnus (Wom.) South Australia.
Holcotrombidium scalaris (Wom.) New Zealand.
Holcotrombidium dentipile (Canest.) Ceylon.
Laminothrombium myrmicum (Wom.) South Australia.
Foliotrombidium evansi (Wom.) gen. nov. Tasmania.
Foliotrombidium bisetosum sp. nov. Victoria, Queensland.
Foliotrombidium ornatum sp. nov. South Australia.
Foliotrombidium kohlsi sp. nov. New Guinea.
Hiotrombidium tubbi (Wom.) gen. nov. Victoria.
Hiotrombidium healslipi (Wom.) Queensland.
Hiotrombidium koordanum (Hirst). Western Australia.
Hiotrombidium canberraense sp. n. Australian Capital Territory.
Pedotrombidium kohlsi gen. et sp. nov. New Guinea.
Platytrombidium paranum (Hirst) South Australia.
Platytrombidium pritchardi (Wom.) New Zealand.
Platytrombidium fusciforme sp. n. New Guinea.

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AUSTRALIAN CUMACEA. No. 12[1]
THE FAMILY DIASTYLIDAE (PART 2) GYNODIASTYLIS AND RELATED GENERA

BY HERBERT M. HALE, DIRECTOR, SOUTH AUSTRALIAN MUSEUM

Summary

A few Diastylids have been described which are separated from all others by the facts that while the female third maxilliped lacks an exopod the male has no trace of pleopods. Species previously known to have these characters in combination have been placed in three genera, Gynodiastylis Calman, Allodiastylis Hale and Dic Stebbing; the female is unknown in the genotype of the last-named but as stated by Zimmer (1914, p. 192) it seems undoubtedly very close indeed to Gynodiastylis.

AUSTRALIAN CUMACEA. No. 12[1]

THE FAMILY DIASTYLIDAE (PART 2) *GYNODIASTYLIS* AND RELATED GENERA

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Fig. 1–60.

INTRODUCTION.

A FEW Diastylids have been described which are separated from all others by the facts that while the female third maxilliped lacks an exopod the male has no trace of pleopods. Species previously known to have these characters in combination have been placed in three genera, *Gynodiastylis* Calman, *Allodiastylis* Hale and *Dic* Stebbing; the female is unknown in the genotype of the last-named but as stated by Zimmer (1914, p. 192) it seems undoubtedly very close indeed to *Gynodiastylis*.

Australian species belonging to *Gynodiastylis* and to some other genera with subcordate, subcylindrical or short and plump telson show that a reduction to vanishing point of the pair of terminal telsonic spines so generally typical of the family is not a very significant feature, and by itself cannot be relied upon as a generic character; in *Allodiastylis* and *Zimmeriana* gen. nov. there is sexual difference in the armament of the telson (see also Hale, 1945, p. 179).

The group under discussion is well represented in Australian waters and twenty-six new species, mostly from off the eastern coast, are herein described. Although, unfortunately, few of these can be included in them, three new genera are proposed in an effort towards preventing *Gynodiastylis* (which as it is now includes a very varied assemblage of forms) from eventually becoming the repository for a large number of unclassified species.

FAMILY DIASTYLIDAE.

KEY TO GENERA OF *DIC–GYNODIASTYLIS* GROUP.

1. Third maxilliped with ischium greatly expanded .. .. .. *Dic* Stebbing.
   Third maxilliped with ischium not expanded .. .. 2.
2. Female with exopods on at least first and second peraeopods. Adult male (where known) with terminal telsonic spines absent or similar to those of female .. .. 3.
   Female with thoracic exopods completely absent. Adult male with terminal telsonic spines which are long and bristle-like, much greater in length than the rudimentary ones of female .. .. 5.
3. First antenna unusually large; the first segment of peduncle is dilated distally, while the second, which reaches beyond level of apex of pseudorostrum, is expanded proximally *Sheardia* gen. nov.
   First antenna small or moderate, with the proximal segments of peduncle not at all dilated, and the second not reaching to level of apex of pseudorostrum .. .. .. 4.

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(1) No. 11, The Family Diastylidae (part i) see *Trans. Roy. Soc., S. Aust.*, lxix (2), 1945, pp. 173–211, fig. 1–26.

4. Female with exopods on first and second pairs of peraeopods only. First peraeopod with propodus not very large, at most barely more (usually much less) than half as long as basis *Gynodiastylis* Calman.

   Female with exopods on first to fourth peraeopods. First peraeopod with propodus very large, at least little shorter than basis .. .. .. *Dicoides* gen. nov.

5. First antenna with third segment of peduncle distinctly longer than combined lengths of the dilated first and second segments. First peraeopod shorter than cephalothorax, its dactylus with no brush of very long setae. Pseudorostrum upturned in female and young male *Allodiastylis* Hale.

   First antenna normal, the third segment of peduncle much shorter than combined lengths of first two joints, which are not dilated. First peraeopod longer than cephalothorax, its dactylus with a brush of very long setae radiating from distal half. Pseudorostrum not upturned .. .. *Zimmeriana* gen. nov.

GENUS SHEARDIA nov.

Female. The first antennae are much as in *Allodiastylis* (particularly *A. tenuipes* sp. nov.), and have the two proximal segments greatly expanded; the third joint, however, although much elongated is shorter in relation to the rest of peduncle. The whole appendage is more than half as long as the carapace.

While the prominently enlarged and projecting basal joints of the first antenna separate this from all other of the related genera except *Allodiastylis*, it is distinguished from the last-named by the absence of long distal setae on the pseudorostrum (which is not upturned) and by the presence of well-developed exopods on the first and second peraeopods. The telson is very different; as a whole it is small, with preanal portion very short, and post-anal part rather long for the group and armed with a pair of unusually stout spines.

Genotype *Sheardia antennata* sp. nov.

Like *Gynodiastylis* but differing in the character of first antenna and telson. In species of *Gynodiastylis* having the telson proportionately as short, there is no post-anal part.

The genus is named after Mr. Keith Sheard, who is responsible for the securing of much of the material dealt with herein.

SHEARDIA ANTENNATA sp. nov.

Ovigerous female. Integument calcified, and chalky-opalescent in appearance; with fine reticulate patterning, particularly distinct on pedigerous somites.

Carapace less than one-third of total length of animal, considerably wider than deep and two-thirds as long again as deep: seen from above it is subtriangular in shape, broadest posteriorly and irregular laterally because of a dorso-lateral elongate tumidity on each side below frontal lobe and a distinct hollow below and to the rear of this elevation; the posterior two-thirds of the dorsum is depressed with the median portion and lateral edges of the hollow raised in the form of rounded folds; inside each rear corner of frontal lobe is a low boss. Antero-lateral margin almost straight, and antennal angle well defined, subacute and finely serrate, the tiny teeth continued along inferior margin. Pseudorostrum narrowly truncate in front, the lobes meeting for a distance equal to about one-fifth of length of carapace. Frontal lobe wide, distinctly defined; ocular lobe twice as broad as long, with three very ill-defined lenses.

Pedigerous somites together three-fourths as long as carapace. First not much shorter than second, which is shorter than any of posterior three and has the pleural parts forwardly produced; third and fourth fused together, the third forwardly produced laterally (where it overlaps second) and bent backwards so that second and third peraeopods are well separated; there is a pair of low dorso-lateral ridges on fourth but no other defined sculpture save the fine median line so often present.

Pleon robust, shorter than cephalothorax; fifth somite rather elongate, not much wider than deep and half as long again as sixth somite, which is widened distally, where it is slightly broader than long; telson two-thirds as long as sixth somite, cordate, with preanal portion very short but longer than the tapering post-anal part, which bears a pair of large distal spines flanked by a pair of bristles.

First two joints of peduncle of first antenna curiously articulated (fig. 2, ant. 1); first segment about as deep as long, the upper portion elevated anteriorly and furnished with a hooked spine, the front margin with a plumose seta; second segment much elevated above and at the rear, its summit higher than that of

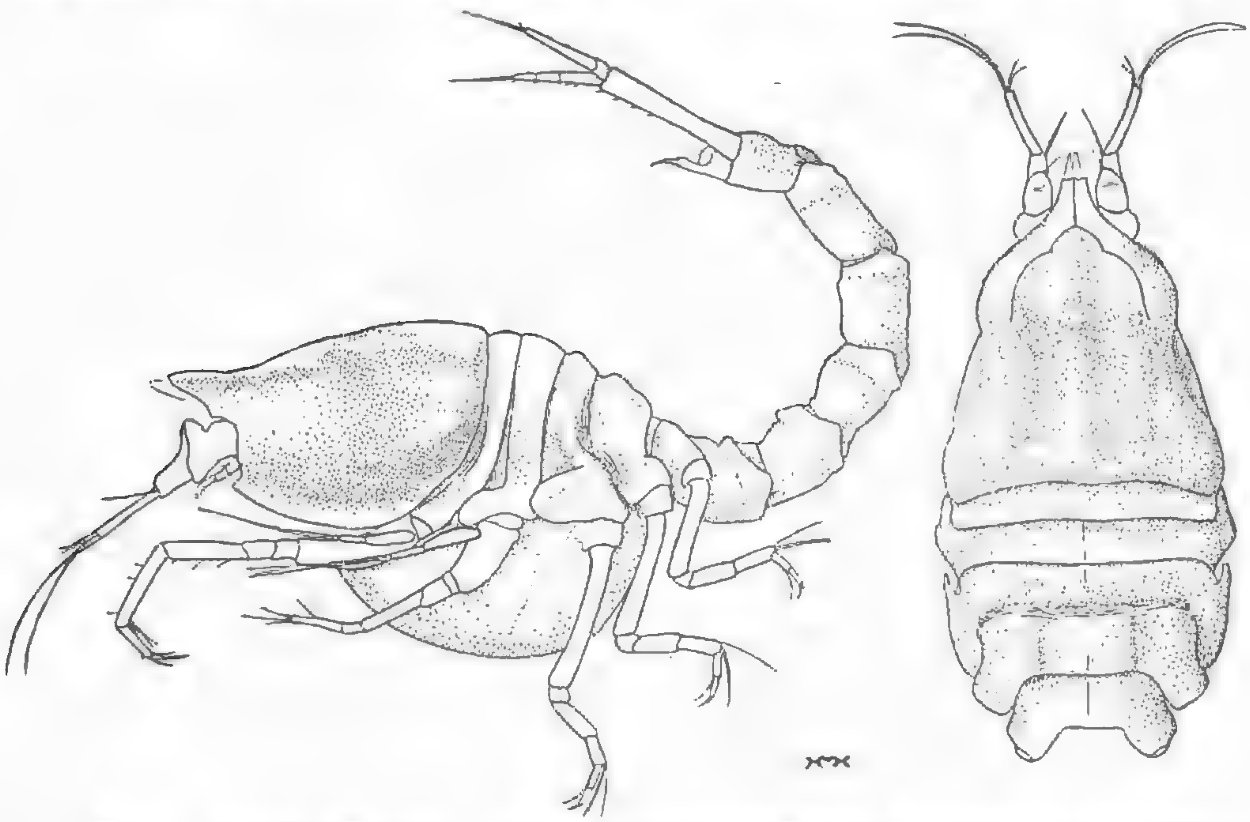

Fig. 1. *Sheardia antennata*, type female; lateral view and cephalothorax from above. (× 28).

first; distal end of second with a strong spine-like seta; third peduncular joint about one-fourth as long again as second; flagellum three-jointed, less than one-fourth as long as third peduncular joint; accessory lash three-jointed, about three-fourths as long as main flagellum.

Second antenna three-jointed, the distal segment stout and with apical seta.

Mandible with ten spines in the row.

Basis of third maxilliped stout and short, as long as first four of the remaining joints together, serrate on outer margin and with long stout setae at external distal portion; carpus and propodus subequal in length, each about twice as long as dactylus.

First peraeopod, when extended, with carpus reaching to level of end of pseudorostrum; basis half as long as rest of limb, without spines, serrate on outer edge; propodus very slightly longer than carpus and fully twice as long as dactylus, with two long setae and one short one at inner distal end; dactylus with one of the several terminal setae spine-like, and as long as the joint.

Second peraeopod reaching forward almost to level of antennal angle; basis very short, only two-thirds as long as exopod and less than half as long as remaining joints combined; ischium distinct; carpus twice as long as merus and as long as propodus and dactylus together; dactylus twice as long as propodus.

Posterior peraeopods with sparse setae. Third and fourth pairs about as long as second leg, with basis nearly as long as rest of limb; merus and carpus

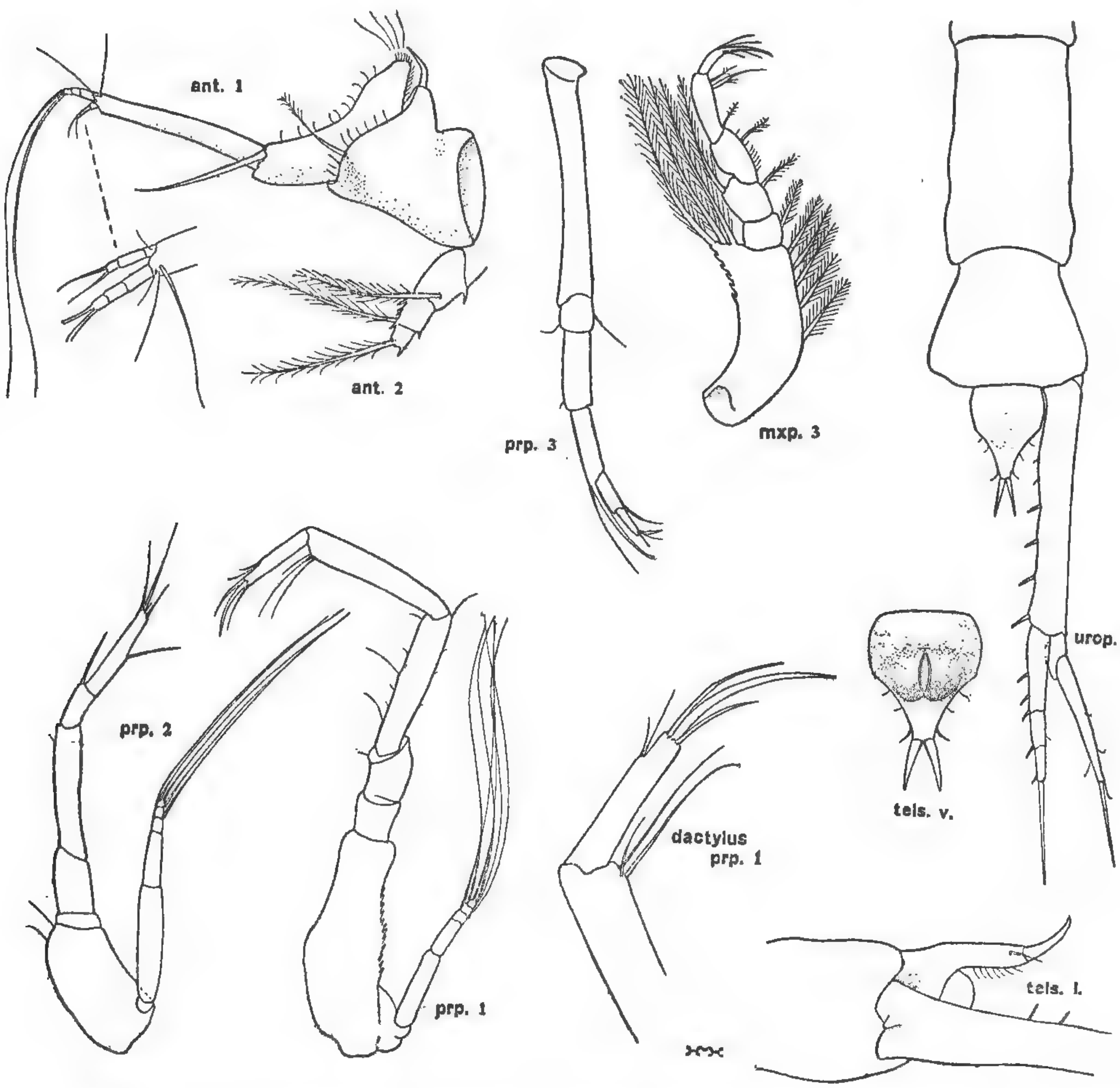

Fig. 2. *Sheardia antennata*, paratype ovigerous female; ant., first and second antennae (× 75); mxp. and prp., third maxilliped and first to third peraeopods (× 56; dactylus of first peraeopod, × 112); urop., uropod with fifth and sixth pleon somites, and telson (× 56); tels. l. and v., lateral and ventral views of telson (× 75).

subequal in length, each twice as long as propodus; carpus with two equal distal setae, one much stouter than the other, reaching to level of tip of dactylus. Fifth peraeopod not much smaller than fourth but with basis shorter.

Peduncle of uropod with four strong spines on distal half of inner margin; it is two and three-fourths times as long as telson and fully half as long again as the rami, which are subequal in length, the exopod slightly the longer; first

joint of endopod with three inner spines, longer than combined lengths of second and third, which are subequal in length and have each one inner spine; terminal spine two-thirds as long as ramus, extending slightly beyond tip of exopodal spine.

Length 4·1 mm.

Loc. New South Wales: Ulladulla, Brush Island, 45 fath., in fine silt on flathead grounds (D. Rochford, Jan., 1945). Type in South Australian Museum, Reg. No. C. 2699.

Genus GYNODIASTYLIS Calman

Gynodiastylis Calman, 1911, pp. 312, 366; Stebbing, 1912, p. 146 and 1913, p. 161; Zimmer, 1914, p. 187 and 1930, p. 651.

This genus was instituted by Calman to include four species, in all of which the telson is plump, subconical, with no post-anal portion and without the pair of distinct terminal spines so generally characteristic of the family; in addition, the third maxilliped of the females has no exopod, while the males were unique in the family in that they lack all trace of the usual two pairs of pleopods. Three of Calman's species are rather robust in form and have the carapace carinate; the fourth—*laevis*—is smooth and elongate, with the second and fourth pedigerous somites dorsally unusually long. Zimmer (1914, pp. 187, 189, fig. 14-16) added two Australian species somewhat resmebling *laevis* in form, which he designates the "*Diastylopsis*-Habitus." The present writer later added another carinate species which, like those of Zimmer, agrees with Calman's forms in having the telson unarmed, and also a smoother species with small telsonic spines.

A score of further species—all but one new—are now referred to the genus. All the females agree in lacking an exopod on the third maxilliped, while the males, where available, have no pleopods, but a great deal of latitude is allowed for the telson; this may have part of its length, as much as fully one-third of it, post-anal, and may have a pair of terminal spines, and in some cases a pair of lateral spines also. Its lateral margins may be more or less distinctly serrate, or may be incised to form one or more pairs of teeth, a feature found elsewhere in the Diastylidae. It would appear, indeed, that the species previously included in the genus happen to be some of those in which the reduction of post-anal part and armature are carried to the greatest extreme, and that many of them do not depart so drastically from the key character of the family.

As the first of the forms with telson armed and with post-anal portion came to hand it was thought that they represented a genus easily separable from *Gynodiastylis* by this character. With more material, however, it became apparent that intermediate stages occur, and that as far as the spines alone are concerned there may be some little difference between the sexes (*truncatifrons* Hale). Furthermore, obviously related forms of "*Diastylopsis*-Habitus" such as *attenuata* sp. nov. and *ambigua* sp. nov. have in the one case the telson unarmed and without post-anal part, in the other a telson with a small portion of its length post-anal, armed with distinct terminal and lateral spines and with the sides serrate. Exactly the same difference may apply to "carinate" forms, for instance *lata* sp. nov. and *ampla* sp. nov. The telson, then, is of little assistance in the grouping of the species. Turning to other characters the first peraeopod proves of some interest and in the key given below the species are divided into two groups by the character and length of the setae of the propodus and the relative length of that joint. In Calman's species these differences are found between *laevis* and his other three forms. It will be noted that in both sections there occur similar differences in the telson and similar variations of the "*Diastylopsis*-Habitus."

Several species in the collections now under consideration are represented only by specimens lacking part of the front legs. Three of these are described and so, necessarily, are placed in both sections of the key, where they are marked with an asterisk; *rochfordi* sp. nov. almost certainly belongs in the first group.

The inclusion in *Gynodiastylis* of species with telson armed and with post-anal part renders more difficult concise diagnosis to assist separation of females of this genus from those of *Paradiastylis;* the male of the last-named of course is readily recognized by the long flagellum of the second antennae and the development of pleopods. There are, however, quite marked differences in the peraeopods; apart from those already referred to (Hale, 1945, p. 173) there are, for instance, the thickened and shortened distal carpal seta of the stout third to fifth legs, referred to in the descriptions, which is usually found in *Gynodiastylis,* but apparently not in the few species belonging to *Paradiastylis.* The uropods in the latter have the peduncle long and slender, whereas in *Gynodiastylis* it is wider. Incidentally, the fact that less than three segments are apparent in the endopod of this appendage in some species of *Gynodiastylis* is important only as a specific character, and the number of joints may differ in the sexes.

Dic (Stebbing 1910, p. 415) has the first peraeopods of the same type as in *Gynodiastylis,* although the propodus is relatively longer than in those species with elongate carpus, and the cylindrical telson is much longer than in any of the species included in *Gynodiastylis.* While these characters are perhaps not of great importance I think that *Gynodiastylis* should remain separated from *Dic* because of the difference in the third maxilliped, even if this appendage proves to lack the exopod in the female of Stebbing's genus. The same holds for *Zimmeriana* gen. nov. whatever the condition of thoracic exopods may be in the female of *Dic* (see Zimmer, 1914, pp. 192-193).

As previously noted, the armament of the male telson does not differ markedly from that of the male. In the male the flagellum of the second antenna is short (as a rule not much longer than peduncle), stout, and furnished with dense sensory setae, while exopods are present on the first four pairs of legs, the first three, or on first and second only. The first antenna, as in the other available adult males of the group, differs little from that of the females and is not furnished with the dense brush of sensory setae occurring in some other Diastylid genera; incidentally, Calman (1912, p. 669) suggests that such setae are situate on the enlarged proximal segment of the outer flagellum rather than on a separated area of the third peduncular joint.

KEY TO SPECIES OF *GYNODIASTYLIS.*

1. Propodus of first peraeopod with eight to twelve setae, subequal in length and at least almost twice as long as combined lengths of propodus and dactylus; carpus of same limb elongate, almost twice as long as propodus, or more .. .. 2.
   Propodus of first peraeopod with one to four unequal setae, the longest at most little more than combined lengths of propodus and dactylus; carpus of same limb usually not differing greatly in length from propodus, at most barely more than half as long again as it .. 17.

2. Carapace sculptured, with at least five ridges on each side .. .. .. 3.
   Carapace smooth, or with at most three ridges on each side .. .. .. 7.

3. Endopod of uropod unisegmentate in both sexes .. .. *carinata* Calman.
   Endopod of uropod bi- or trisegmentate .. .. 4.

4. Telson with one-fourth of its length post-anal and armed with a pair of distinct terminal spines. Endopod of uropod trisegmentate in male .. .. **rochfordi* sp. nov.
   Telson with no definite post-anal portion, unarmed or with rudimentary terminal spines. Endopod of uropod bisegmentate in both sexes .. .. 5.

5. First segment of endopod of uropod much shorter than second .. .. *lata* sp. nov.
   Segments of endopod of uropod subequal in length .. .. 6.

6. Exopod of uropod not much shorter than endopod. Sixth pleon somite but little broader than long .. .. *costata* Calman.
Exopod of uropod only three-fifths as long as endopod. Sixth pleon somite half as wide again as long .. .. *turgida* Hale.

7. Carapace with surface irregular, with a pair of dorso-lateral ridges or folds, and with a large shallow depression on sides .. .. 8.
Carapace with surface smooth or almost so, with no dorso-lateral ridges, and no large depression on sides .. .. 12.

8. Lower part of sides of carapace without longitudinal ridge or fold *bicristata* Calman.
Lower part of sides of carapace with a longitudinal ridge or fold .. .. 9.

9. Rami of uropod as long, or almost as long, as peduncle .. .. .. 10.
Rami of uropod short, at most less than two-thirds as long as peduncle .. .. 11.

10. Inner margins of peduncle and trisegmentate endopod of uropod with many short spines (13 + 19). Female only .. .. **robusta* sp. nov.
Inner margins of peduncle and bisegmentate endopod of uropod with few spines (2 to 3 + 6 to 8). Males only .. .. *dilatata* sp. nov.

11. Telson with only an insignificant post-anal portion. Carapace with folds but no sharply defined ridges, and with branchial regions swollen. Peduncle of uropod more than twice as long as endopod .. .. **strumosa* sp. nov.
Telson with almost one-third of its length post-anal. Carapace with distinct carinae but with branchial regions not swollen. Peduncle of uropod much less than twice as long as endopod .. .. *ampla* sp. nov.

12. Telson with one-third of its length post-anal .. .. .. *subtilis* sp. nov.
Telson with at most an insignificant post-anal portion .. .. .. 13.

13. Each pseudorostral lobe with a sharp dorsal carina, extending from front to ocular lobe *carinirostris* sp. nov.
Pseudorostral lobes not carinate .. .. 14.

14. Antero-lateral angle of carapace denticulate. Telson with distinct spines at distal end .. 15.
Antero-lateral angle of carapace not denticulate. Telson unarmed .. .. 16.

15. Carapace with anterior half of inferior margin serrate. Second peraeopod with ischium suppressed, and with carpus twice as long as propodus and dactylus together. Dactylus of second to fifth peraeopods about three times as long as propodus *truncatifrons* Hale.
Carapace with inferior margin not serrate except at antero-lateral angle. Second peraeopod with ischium distinct, and with carpus not longer than propodus and dactylus together. Dactylus of second to fifth peraeopods barely or not longer than propodus *polita* sp. nov.

16. Endopod of uropod trisegmentate in female .. .. *hartmeyeri* Zimmer.
Endopod of uropod bisegmentate in female (unisegmentate in male) .. *similis* Zimmer.

17. Carapace smooth .. .. 18.
Carapace with spines, tubercles, ridges or tumidities .. .. .. 20.

18. Telson with lateral margins serrate, and with a pair of terminal spines, each flanked by a lateral spine .. .. *ambigua* sp. nov.
Telson unarmed, and with lateral margins entire .. .. 19.

19. Endopod of uropod unisegmentate. Male with exopods on first and second peraeopods only *laevis* Calman.
Endopod of uropod bisegmentate. Male with exopods on first, second and third peraeopods *attenuata* sp. nov.

20. Sides of carapace closely beset with spines .. .. *echinata* sp. nov.
Sides of carapace not spiny .. .. 21.

21. Sides of carapace studded with small glassy tubercles .. .. *roscida* sp. nov.
Sides of carapace without such tubercles .. .. 22.

22. Each side of carapace with a well-defined ridge, curving up from neighbourhood of antennal angle to meet a dorso-lateral ridge .. .. 23.
Carapace without this transverse ridge .. .. 24.

23. Telson with at least one pair of lateral teeth and, in adult, with apex pointed and projecting for a short distance beyond bases of a pair of subterminal spines. Endopod of uropod unisegmentate in both sexes .. .. *mutabilis* sp. nov.
Telson with lateral margins entire, its narrowly subtruncate apex with a pair of small spines. Endopod of uropod bisegmentate in both sexes .. .. *ornata* sp. nov.

24. Rami of uropod unusually short, less than half as long as the peduncle .. .. 25.
Rami of uropod usually almost as long as peduncle and always much more than half as long as it .. .. 26.

25. Telson with an insignificant post-anal portion, armed with a pair of terminal spines flanked by a pair of short lateral spines. Endopod of uropod trisegmentate (female) *strumosa* sp. nov.
Telson with slightly longer post-anal portion, armed with a pair of terminal spines, flanked on each side by a long bristle. Endopod of uropod bisegmentate in both sexes *margarita* sp. nov.

26. Lower part of sides of carapace with four longitudinal ridges .. *rochfordi* sp. nov.
Lower part of sides of carapace with at most one longitudinal ridge .. .. 27.

27. Carapace with two pairs of longitudinal ridges on posterior half of dorsum. Telson unarmed *quadricristata* sp. nov.
Carapace with one pair of longitudinal ridges on back. Telson armed with at least a pair of terminal spines .. .. 28.

28. Carapace almost smooth and without distinct excavation on the sides, which, as seen from above are evenly curved. Each lateral margin of telson incised to form a large tooth *brevipes* sp. nov.
Carapace with large lateral depressions, so that the sides, as seen from above, are not evenly curved. Lateral margins of telson smooth or finely serrate, with no large teeth .. 29.

29. Second peraeopod with basis longer than the abbreviated remainder of limb *concava* sp. nov.
Second peraeopod with basis shorter than rest of limb .. .. .. 30.

30. Dorso-lateral carinae of carapace with prominent lateral projections in adult. Telson with a bristle on each side near terminal spines. Carpus of second peraeopod not as long as propodus and dactylus together .. .. .. *tumida* (Hale).
Dorso-lateral carina of carapace without projections. Telson with a short spine on each side of terminal spines. Carpus of second peraeopod longer than propodus and dactylus together .. .. *robusta* sp. nov.

GYNODIASTYLIS ROCHFORDI sp. nov.

Subadult male. Integument rather strongly calcified and brittle.

Carapace a little less than two-fiths of total length of animal and twice as long as the pedigerous somites together; it is depressed, fully twice as long as deep, and is marked with clear cut longitudinal carinae; a pair of these are dorso-lateral,

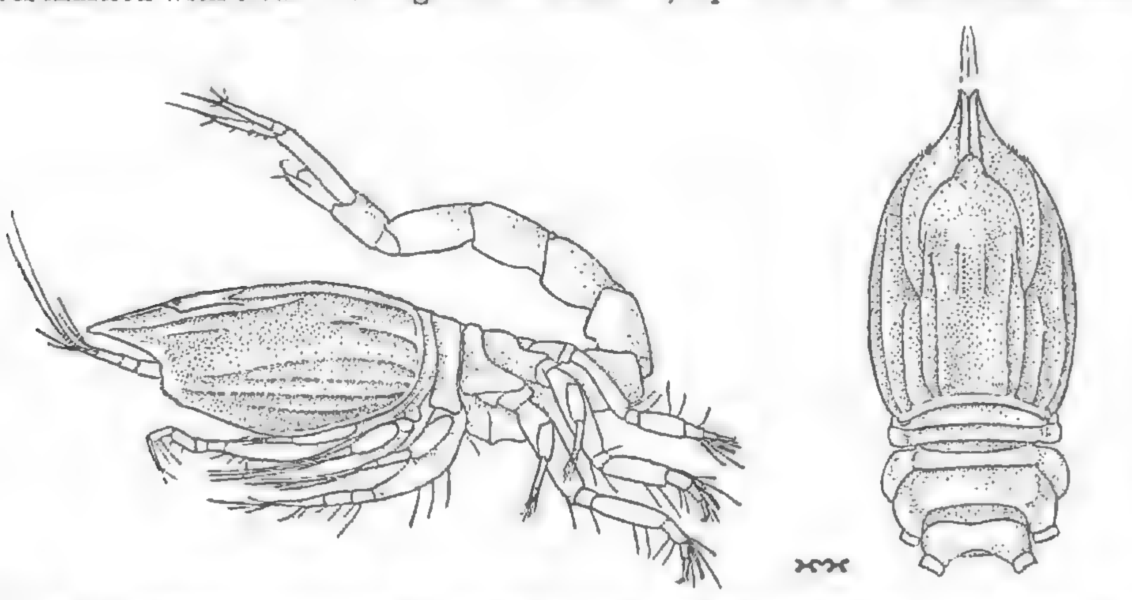

Fig. 3. *Gynodiastylis rochfordi*, type subadult male; lateral view and cephalothorax from above (× 25).

arising on sides of pseudorostrum, curving around outside of frontal lobe and each meeting a ridge running from just inside end of suture of frontal lobe and extending to hind margin; inside these is a pair of dorsal ridges on posterior half, with a pit alongside their hinder ends, and inside these again a pair of shorter ridges at

middle of length of carapace; there is a short ridge on each pseudorostral lobe, extending from apex to ocular lobe; the sides have several short carinae and, in lower half, four longer ones, the uppermost of which margins an elongate lateral depression. Antero-lateral margin not excavate below pseudorostrum; antero-lateral angle rounded and finely serrate. Pseudorostrum prominent, the lobes gaping slightly at apex; subacute in front as seen from the side, and meeting for a distance equal to nearly one-fourth of length of carapace. Frontal lobe well-defined; ocular lobe subtriangular, little wider than long, with three small pale corneal lenses.

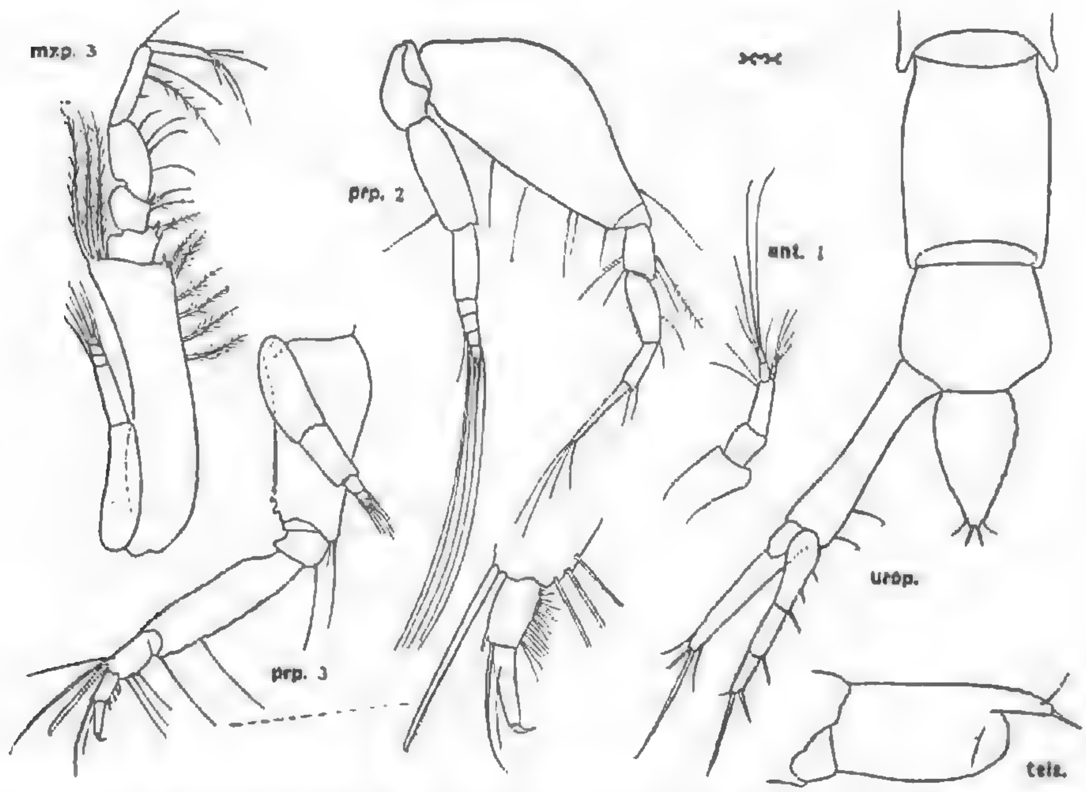

Fig. 4. *Gynodiastylis rochfordi*, type subadult male; ant., first antenna (× 56); mxp. and prp., third maxilliped, and second and third peraeopods (× 56; propodus and dactylus of third leg, × 120); urop., uropod with fifth and sixth pleon somites, and telson (× 56); tels., lateral view of telson (× 80).

First three pedigerous somites dorsally short, each shorter than fifth, which is not as long as fourth; the pleural parts of third are well produced backwards, so that second and third legs, particularly for a not fully adult male, are quite markedly separated.

Pleon fully as long as cephalothorax; fifth somite quite half as long again as sixth, which is only slightly expanded posteriorly and is not much wider than long; telson as long as sixth somite, subcordate, with lateral margins feebly serrate and with a pair of slender terminal spines, just anterior to which is an upstanding bristle on each side; one-fourth of total length of telson is post-anal.

First joint of first antenna about as long as rest of peduncle; second segment three-fourths as long as third; flagellum two-jointed, not as long as second peduncular joint, and accessory lash three-jointed, fully half the length of main flagellum.

Third maxilliped as long as the remaining joints together; carpus, propodus

and dactylus long, each about equal to combined lengths of ischium and merus, which bear inner distal teeth.

Distal joints of first peraeopod missing.

Second peraeopod with exopod longer than basis, which is stout and very little longer than rest of limb; ischium marked off by a suture but not distinctly articulated; merus (which has a small outer tooth near distal end) as long as propodus, and fully two-thirds as long as carpus; the last-named is as long as the dactylus, which bears slender distal setae, the longest exceeding the joint in length.

Third and fourth peraeopods with exopods, moderately well-developed but as usual a little smaller than those of first and second legs; merus not much shorter than basis and twice as long as carpus and propodus together; carpus with the last of the distal setae stouter than the others and reaching to tip of dactylus; penultimate outer carpal seta, like the slender propodal seta, reaching well beyond level of tip of dactylus, which is about as long as propodus, and has a very short claw-like terminal portion distinctly separated. Fifth peraeopod a little shorter than fourth, with basis as usual more slender.

Peduncle of uropod half as long again as telson, with two bristles near distal end of inner margin; endopod a little longer than exopod and not much shorter than peduncle; it is three-segmentate, the first joint somewhat shorter than rest of ramus, and with two short spines and one longer spine on inner margin; second joint distinctly longer than third and like it with a single inner spine at distal end; terminal spine of endopod half as long as the ramus and shorter than the longer of the two very unequal terminal spines of exopod.

Colour cream. Length 4 mm.

Loc. New South Wales; Ulladulla, Brush Island, 45 fath., in fine silt on flathead grounds (D. Rochford, Jan., 1945). Type in South Australian Museum, Reg. No. C. 2695.

This species is named after Mr. D. Rochford, Hydrologist, C.S.I.R., Division of Fisheries.

GYNODIASTYLIS lata sp. nov.

Ovigerous female. Carapace fully one-third of total length of animal and more than half as long again as pedigerous somites together; it is half as long again as deep, and seen from above is subtriangular in shape, broadest at hinder end, where it is as wide as long; back and sides with numerous longitudinal carinae; the dorso-lateral ridges are restricted to posterior half, and anterior to them on each side is a large, shallow depression; between the dorsal ridges there are faint eroded pits. Antero-lateral margin excavated to form a large antennal notch; antero-lateral angle produced, acute. Pseudorostral lobes meeting in front of ocular lobe for a distance equal to nearly one-fifth length of carapace, anteriorly gaping slightly for a very short distance; each lobe is pointed in front, both as seen from above and from the side, and on its dorsum has a ridge-like longitudinal fold in front of ocular lobe; sutures fused, so that eye lobe is not well defined. No distinct lenses, but a pair of raised smooth oval areas at front of ocular lobe.

First to third pedigerous somites successively increasing in length dorsally, and as wide as is carapace across hinder end; pleural parts of third and fourth considerably expanded laterally; dorsum of second and third with a pair of obsolete elevations, that of fourth with a pair of longitudinal ridges.

Pleon six-sevenths as long as cephalothorax; fifth somite fully half as long again as sixth, which is broad, half as wide again as long; telson subtriangular in shape as seen from above, and not much shorter than sixth somite; its sides are slightly rounded, and no apical spines are discernible.

First antenna with second joint of peduncle half as long as first and two-

thirds as long as third; accessory flagellum two-thirds as long as main flagellum, which is four-jointed.

Third maxilliped with basis wide, shorter than rest of limb and slightly expanded distally, but not at all forwardly produced; carpus and propodus subequal in length, each a little longer than dactylus, which has one of its distal setae stout and as long as the joint itself.

First peraeopod short, the carpus reaching to level of apex of pseudorostrum; basis half the combined lengths of remaining joints; carpus about as long as basis,

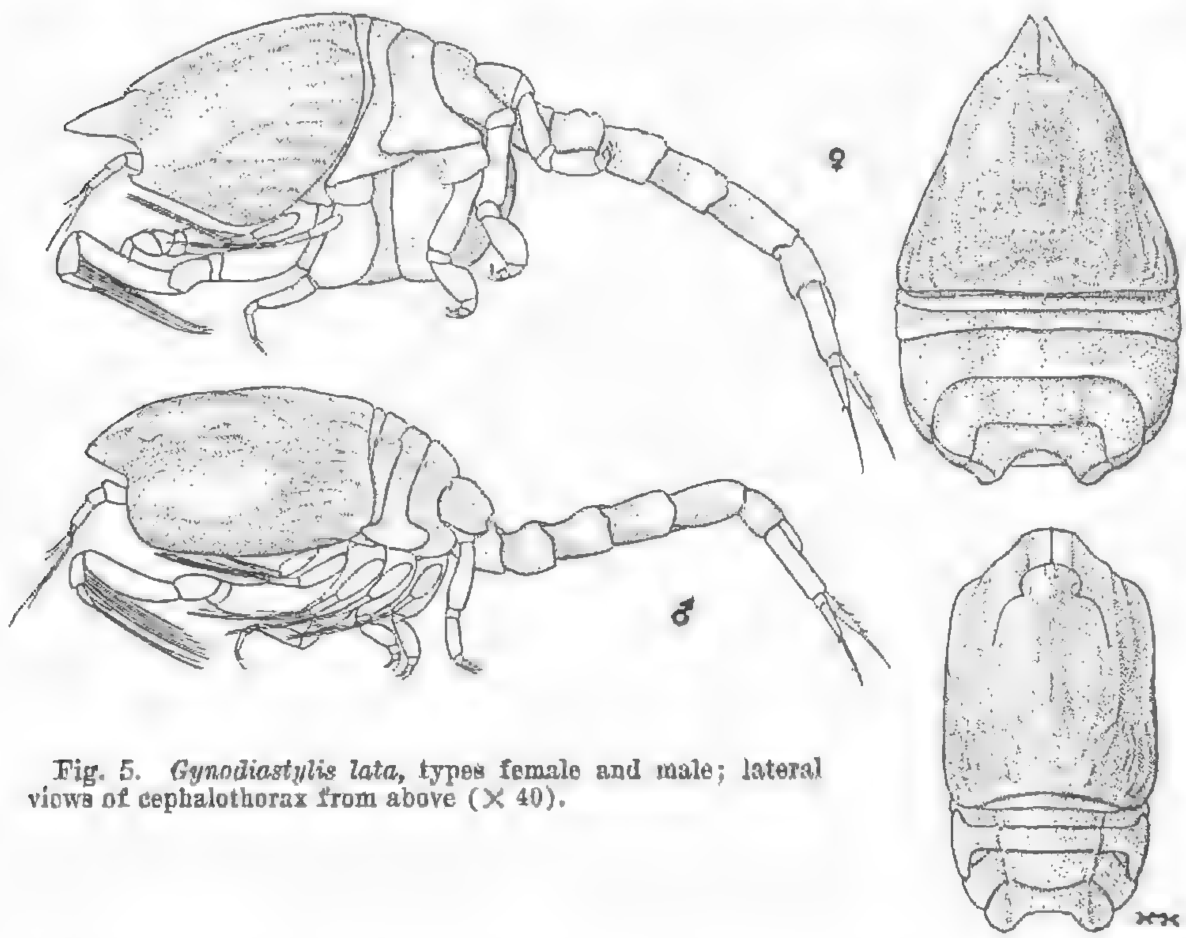

Fig. 5. *Gynodiastylis lata*, types female and male; lateral views of cephalothorax from above (× 40).

more than twice as long as propodus and four times as long as dactylus; like the ischium and merus it bears a few short inner setae; propodus dilated in distal half, the expanded portion bearing a fringe of very long setae; dactylus with similar distal setae; exopod as long as basis.

Second peraeopod with exopod as long as basis, which is broad (width more than half length) and as long as rest of limb; ischium very short, collar-like; carpus half as long again as merus and longer than propodus and dactylus together; propodus fully three-fourths as long as dactylus, which bears a curved distal claw and thinner setae.

Third and fourth peraeopods robust, not much shorter than second; merus broad, more than twice as long as the short carpus and propodus together; dactylus curved, claw-like. Fifth peraeopod scarcely smaller than fourth.

Peduncle of uropod not quite twice as long as telson, with one subdistal spine on inner margin; endopod three-fifths as long as peduncle, and nearly one-third as long again as exopod; two-jointed, the proximal segment about two-thirds as

long as second, with a short inner spine at distal end; second joint with two inner spines and with terminal spine rather slender, longer than the ramus; exopod with terminal spine longer than the ramus, but shorter than that of endopod.

Colour cream. Length 2·2 mm.

Adult male. Carapace more than one-third of total length of animal, nearly twice as long as pedigerous somites together and three-fourths as long again as

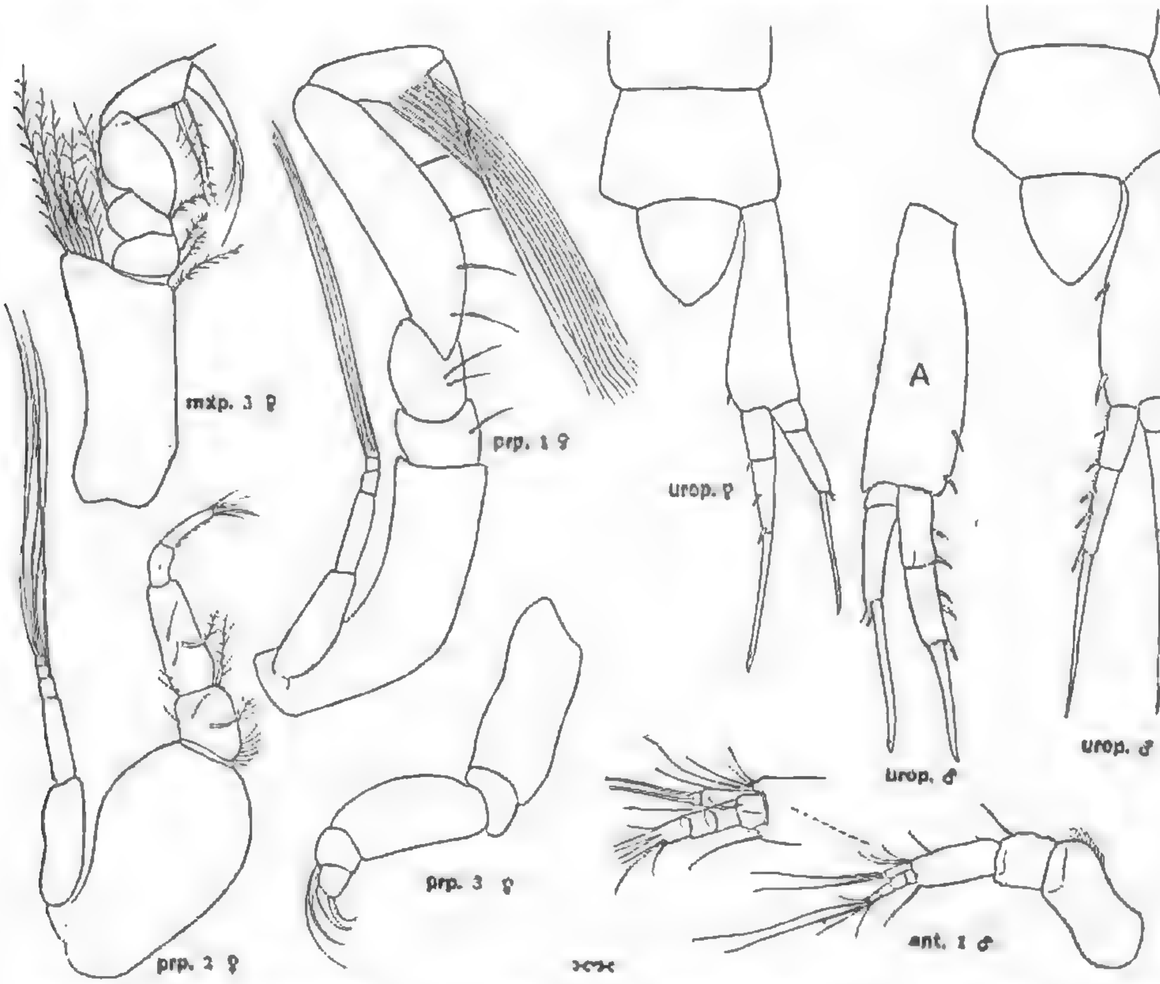

Fig. 6. *Gynodiastylis lata*, type female and paratype male; ant., first antenna (× 125; flagella, × 250); mxp. and prp., third maxilliped and first to third peraeopods (× 125); urop., uropod with sixth pleon somite and telson (× 125). A. urop., Uropod of male of *G. turgida* for comparison (× 125).

its depth, which is equal to about four-fifths its greatest breadth; seen from above it is subrectangular; disposition of ridges much as in female. Antero-lateral margin and "angle" rounded, without trace of tooth. Pseudorostral lobes stouter and shorter than in female, subtruncate in front as viewed from above. Ocular lobe twice as wide as long, with three oval pale areas, apical and lateral, apparently representing the eyes.

Pedigerous somites successively increasing in dorsal length; first somite exposed only dorsally and dorso-laterally; second overlapped by pleural part of third, which also overlaps fourth to the rear; fourth and fifth with pleural parts expanded backwards; second to fifth each with a dorso-lateral ridge on each side.

Pleon much as in female, with distal somites of same proportions.

Well developed exopods (with peduncle not very wide, however) on third maxilliped and first to fourth peraeopods.

Peduncle of uropod more than twice as long as telson, with two small spines on inner margin; endopod three-fifths as long as peduncle, but only about one-sixth as long again as endopod, with proximal joint three-fourths as long as second and with two inner spines; second joint with three inner spines and with terminal spine longer than ramus; terminal spine of exopod fully as long as that of endopod.

Length 2 mm.

Loc. Queensland: Moreton Bay, Myora Bight, surface (I. S. R. Munro, Stations 28 [type loc.], 29, 32, 42, 44, 46, 54 and 55, 40 cm. 60 m. net, 2.30 a.m., 3.30 a.m., 6.30 a.m., 7.00 p.m., 9.30 p.m. and 11.30 p.m. on Nov. 29, 1940; 9.10 p.m. and 9.40 p.m. on Dec. 6, 1940). Types in South Australian Museum, Reg. No. C. 2638-2639.

This species is by no means abundant in the material secured by Mr. Munro, but one or more males at least were taken at each of the townet stations mentioned above, covering afternoon and night. It and *turgida* Hale (1928, p. 42, fig. 11-12 and 1936, p. 420, fig. 10–11) are related to *costata* Calman (1911, p. 372, pl. xxxvi, fig. 1-10), but both differ in the more robust form, the relatively much shorter and broader sixth pleon somite, the shorter first peraeopods and the different proportions of the uropods. In *costata* the sixth pleon somite is "a little broader than long" in both sexes, while the uropod has the rami subequal in length and the first joint of the endopod little shorter than the distal. Both *turgida* and *lata* have the sixth pleon somite half as wide again as long and the rami of the uropod unequal in length. In the uropod of *turgida* the endopod has the joints subequal in length and the stout terminal spine shorter than the ramus (see fig. 6, A), but the exopod is not quite three-fourths the length of the endopod. *G. lata*, as described above, has the exopod of the uropod more as in *costata*, and relatively longer than in *turgida*, but the first joint of the endopod is much shorter than the distal, and the terminal spine of the endopod is longer than the ramus in both sexes.

The most noteworthy of other differences is that the male of *lata* has the antero-lateral margin of the carapace widely rounded and not produced to form an antennal tooth.

GYNODIASTYLIS ROBUSTA sp. nov.

Ovigerous female. Integument well calcified and brittle, with distinct reticulate patterning, and finely and closely granulate.

Carapace robust but relatively short, not much more than one-fourth of total length; it is broadest across the branchial regions, where it is wider than deep and almost as wide as long; on each side below the frontal lobe is a small keeled dorso-lateral tumidity, most apparent in dorsal view when it forms a bulge in the lateral outline; below and posterior to this the sides are shallowly concave and on the lower part a sharp horizontal ridge runs from the neighbourhood of antennal angle to hinder margin; on the back a ridge extends forwards on each side from near posterior margin to join the short carina on the aforementioned dorso-lateral tumidity, cutting across the rear corner of the frontal lobe; from about middle of length of each of the dorsal ridges a short and faint transverse carina runs in towards mid-line; there are two pairs of tubercles behind ocular lobe and a pair of large pits on the back near the swollen hinder margin. Antero-lateral margin very shallowly concave; antero-lateral angle obtusely angular and margin posterior to it finely serrate. Pseudorostrum narrowly truncate and excavate in front; lobes meeting for a distance equal to one-sixth of length of carapace. Frontal lobe well defined, very wide; ocular lobe rounded, twice as broad as long, with three lenses, unpigmented as usual in genus.

First two pedigerous somites short dorsally, but pleural parts of second produced well forwards, almost completely overlapping first; third somite expanded

fore and aft, the second and third legs well separated; fourth somite completely ankylosed with third and with a pair of widely separated longitudinal carinae on the back; the dorso-lateral parts of this somite, like the posterior portions of the sides of the carapace, are marked with numerous very short and inconspicuous horizontal ridges.

Pleon stout, longer than cephalothorax; fifth somite slightly depressed, more than half as long again as sixth, which is a little widened posteriorly, where it is barely broader than long; telson about as long as sixth somite, elongate cordate,

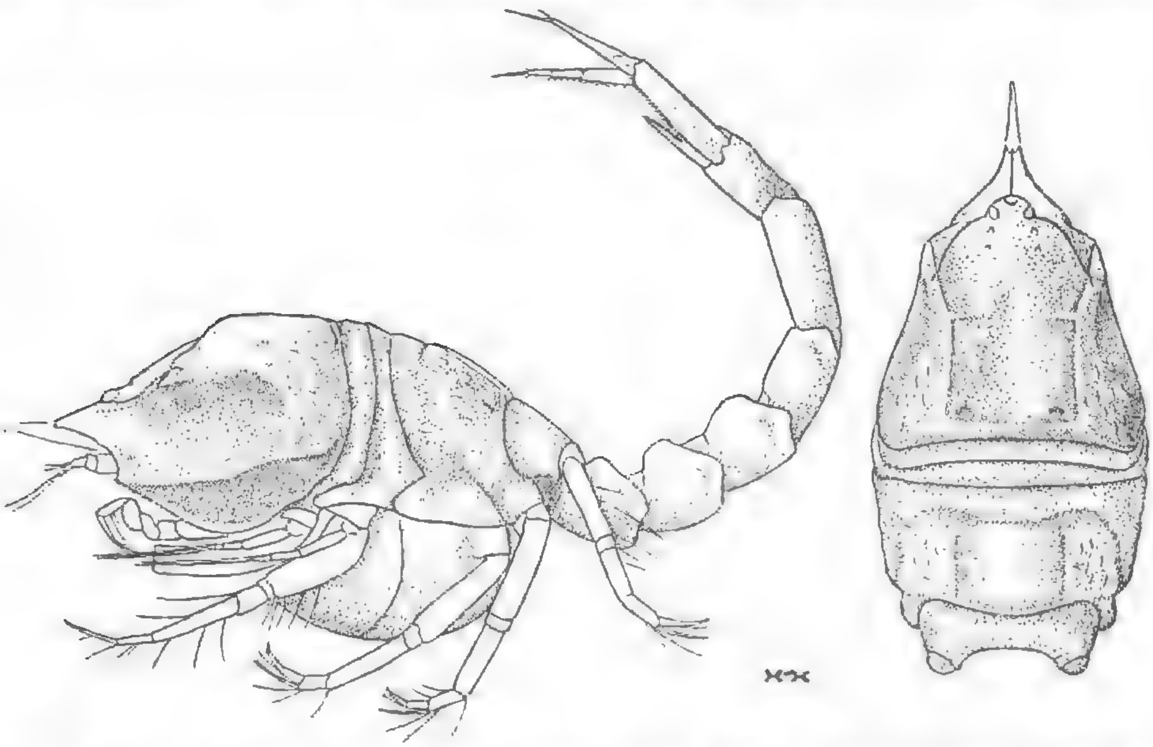

Fig. 7. *Gynodiastylis robusta*, type female; lateral view and cephalothorax from above (× 28).

laterally serrate, and with post-anal part half as long as proximal; apex with a pair of short spines, flanked by a spine on each side.

First antenna relatively rather small (drawn to a larger scale than other appendages in fig. 8); first joint of peduncle stout, but more than twice as long as wide, half as long again as second and third segments together; third narrower than, and three-fourths as long again as, second; flagellum as long as last peduncular joint and with two equal joints; accessory lash three-jointed, less than half length of main flagellum.

Third maxilliped not elongate; basis as long as remaining joints combined, and with the setae at outer distal portion unusually short; basis, ischium and merus with an inner distal tooth; carpus, propodus and dactylus subequal in length.

Distal joints of first peraeopod missing.

Second peraeopod large, slightly longer than third, and reaching just beyond antennal angle when extended forwards; basis about as long as exopod and more than half the length of rest of limb; ischium distinct and quite large; the three distal joints are elongate; carpus two and one-half times as long as merus and fully twice as long as propodus, which is as equal in length to dactylus.

Third and fourth peraeopods differing little in length; they are robust with basis much shorter than rest of limb, and merus as long, or almost as long, as the

three distal joints together; carpus little longer than propodus, with the distal setae (one of which is very stout) subequal in length and not quite reaching to tip of the elongate dactylus.

Uropod with peduncle nearly half as long again as telson, not much longer than the subequal rami, and with a row of short, closely set spines (thirteen in number) on distal two-thirds of inner margin; endopod three-jointed, also with

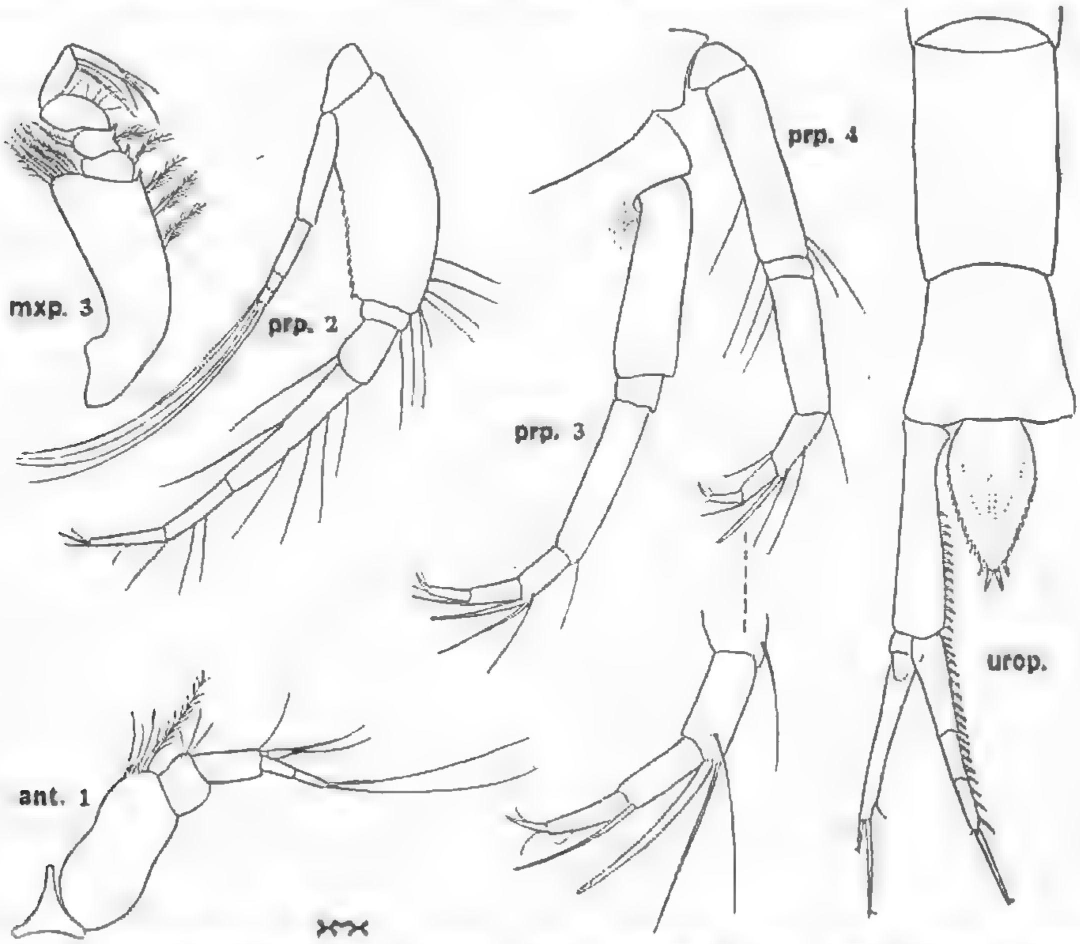

Fig. 8. *Gynodiastylis robusta*, paratype ovigerous female; ant., first antenna and upper lip (× 95); mxp. and prp., third maxilliped and second to fourth peraeopods (× 50; distal joints of fourth leg, × 95); urop., uropod with fifth and sixth pleon somites, and telson (× 50).

inner spines numerous, there being eleven, five and three on the respective segments; first joint as long as combined lengths of subequal second and third; terminal spine less than half length of ramus and not quite as long as longer of the very unequal distal spines of exopod.

Colour white. Length 4·4 mm.

Loc. Tasmania: off Babel Island, 0–50 metres ("Warreen" Station 29, Jan., 1939). Type in South Australian Museum, Reg. No. C. 2724.

It is unfortunate that the terminal joints of the first peraeopods are missing in the two available females, for the species comes close to the males described under *dilatata*. The uropod of the female recorded above, however, is much more richly armed than is that of *dilatata*, while the peduncle of that appendage is a little longer than the endopod instead of shorter than it, the sculpture of the carapace is somewhat different, the size is considerably larger, etc. The difference in number of segments in the endopod could be sexual.

G. robusta may prove to bear the same relationship to *dilatata* as does *Dimorphostylis subaculeata* to its var. *praecox* (Hale, 1945, pp. 183, 185, fig. 7–9)

GYNODIASTYLIS DILATATA sp. nov.

Adult male. Integument lightly calcified, brittle, and with reticulate patterning of carapace distinct, the fine surface sculpture becoming imbricate on the pleon.

Carapace a little less than one-third of total length of animal and twice as long as pedigerous somites together; it is much depressed, being almost half as wide again as deep and is two-thirds as long again as deep; there is a sharp, curved dorso-lateral ridge on each side, partly encircling the front lobe and meeting a longitudinal carina which runs from hinder corner of frontal lobe to posterior margin of carapace; on the frontal lobe and for some distance posterior to it the dorsum is medianly ridged, but towards the rear end it is sulcate between the slightly tumid branchial regions; there is a short dorsal ridge on each pseudorostral lobe, extending from apex to ocular lobe; on the side is an extensive shallow hollow, margined below by a sharply elevated carina extending from antennal angle to

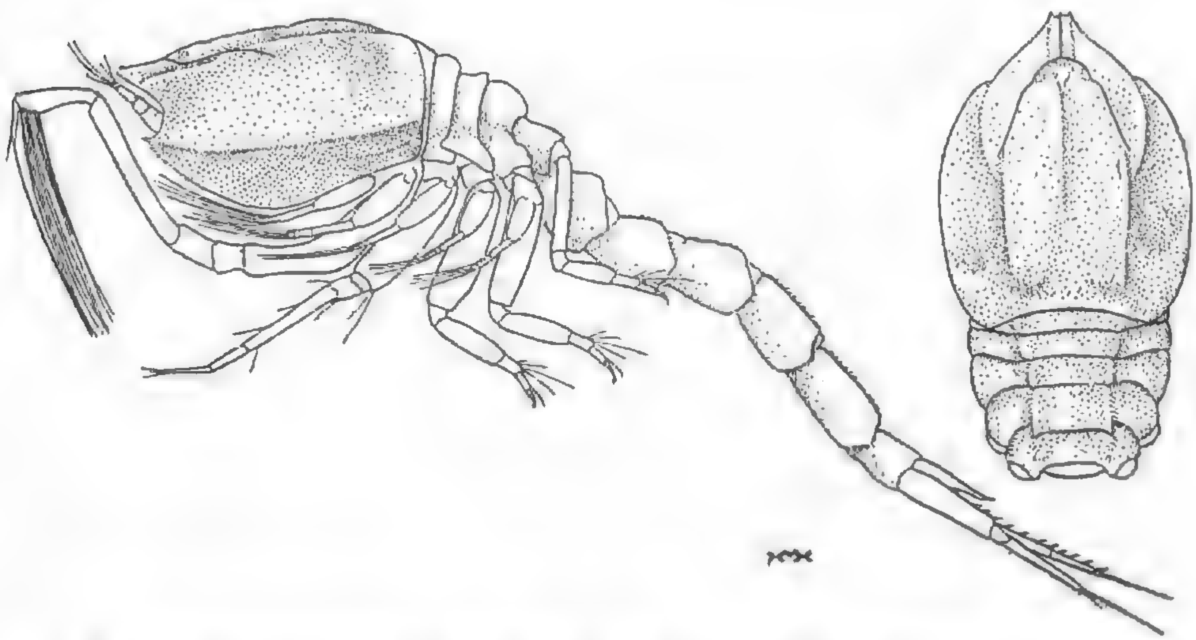

Fig. 9. *Gynodiastylis dilatata,* type male; lateral view and cephalothorax from above (× 35).

posterior margin. Antero-lateral margin very shallowly concave; antennal angle acute and margin posterior to it very finely serrate. Pseudorostral lobes subtruncate in front and shallowly excavate, meeting for a distance equal to one-seventh of length of carapace. Frontal lobe distinctly marked off; ocular lobe more than twice as wide as long and less than one-fourth greatest breadth of carapace; it has three not very large lenses.

First to fourth pedigerous somites successively increasing in dorsal length; second to fourth with a pair of dorso-lateral carinae, first with similar but fainter carinae, and fifth with a pair of dorso-lateral tumidities; third somite moderately produced fore and aft on the sides, but second and third legs separated by an interspace no greater than that between any of the others.

Pleon distinctly longer than cephalothorax, the distal somites rather slender; fifth fully half as long again as sixth, which is scarcely at all dilated posteriorly, where it is as wide as long; telson narrowly cordate, longer than sixth somite but shorter than fifth, and with fully one-third of its length post-anal; it is armed with

a pair of rather long terminal spines, flanked on the left by a lateral spine, on the right side by two spines.

First antenna relatively small and robust; first peduncular joint a little longer than second and third combined, the last little longer than second; flagellum four-segmentate and quite as long as peduncular joint; accessory flagellum fully half as long as main lash, composed of four joints, the last of which is minute. Second antenna with the eleven-segmentate flagellum barely longer than peduncle.

Mandible with nine or ten spines in the row.

Third maxilliped with basis only about one-tenth longer than rest of limb.

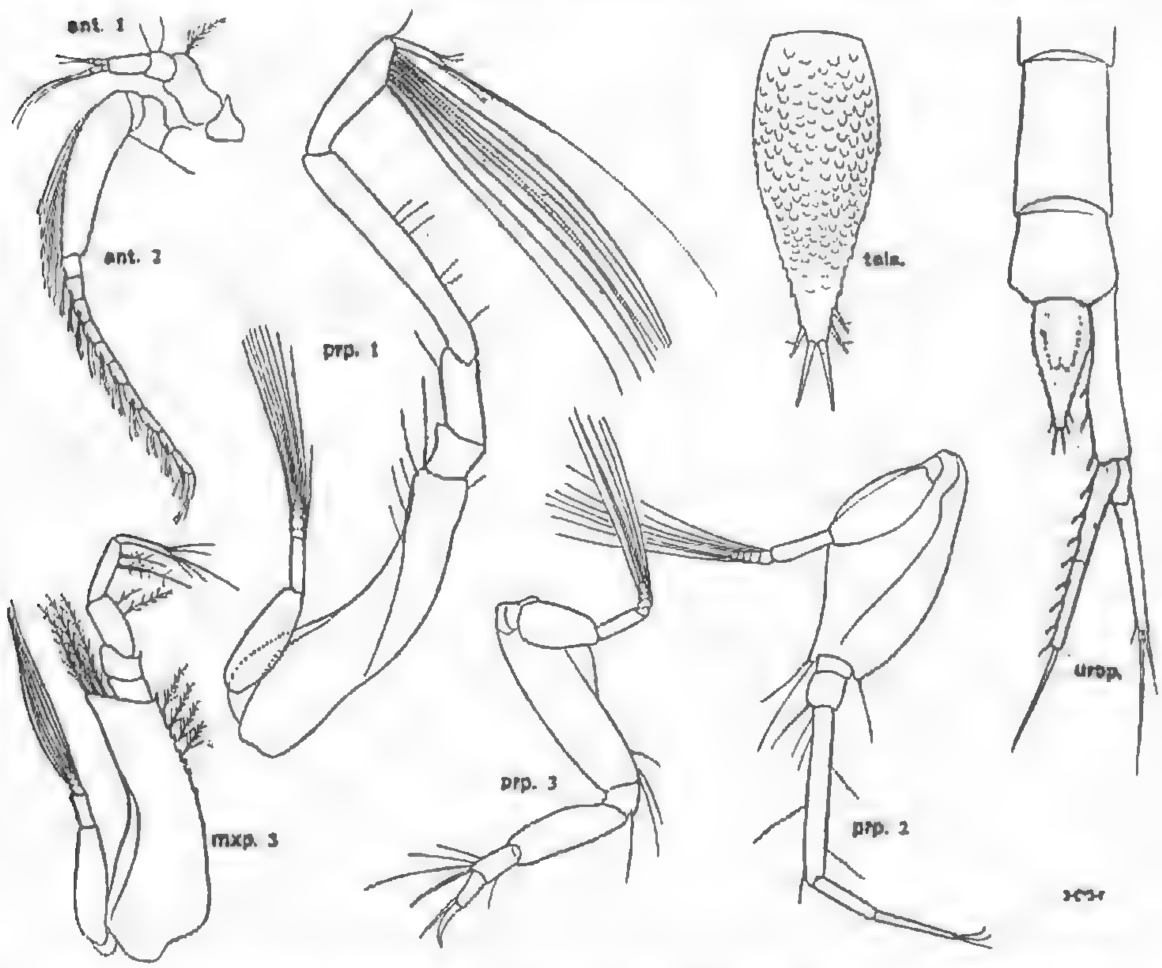

Fig. 10. *Gynodiastylis dilatata*, type male; ant., first and second antennae with upper lip; mxp. and prp., third maxilliped and first to third peraeopods; urop., uropod and fifth and sixth pleon somites, and telson (all × 56); tels., telson (× 125).

First peraeopod long, the carpus reaching beyond level of apex of pseudo-rostrum; basis less than two-thirds as long as rest of limb; carpus elongate, about three-fourths as long as basis, and twice as long as propodus, which is more than twice as long as dactylus; the propodus has, in dilated distal third, a series of long setae which, like terminal seta of dactylus, are almost half the total length of the limb.

Second peraeopod with exopod as long as the stout basis, which is approximately two-thirds the length of rest of limb; ischium relatively large; carpus elongate, and distinctly more than twice as long as propodus, which is five-sixths as long as the slender dactylus.

Third and fourth peraeopods with well-developed exopods and with basis shorter than remaining joints together; merus barely half as long again as carpus and propodus together; the last of the carpal setae is shorter and a little stouter than the preceding seta and, unlike the stout propodal seta, does not reach to

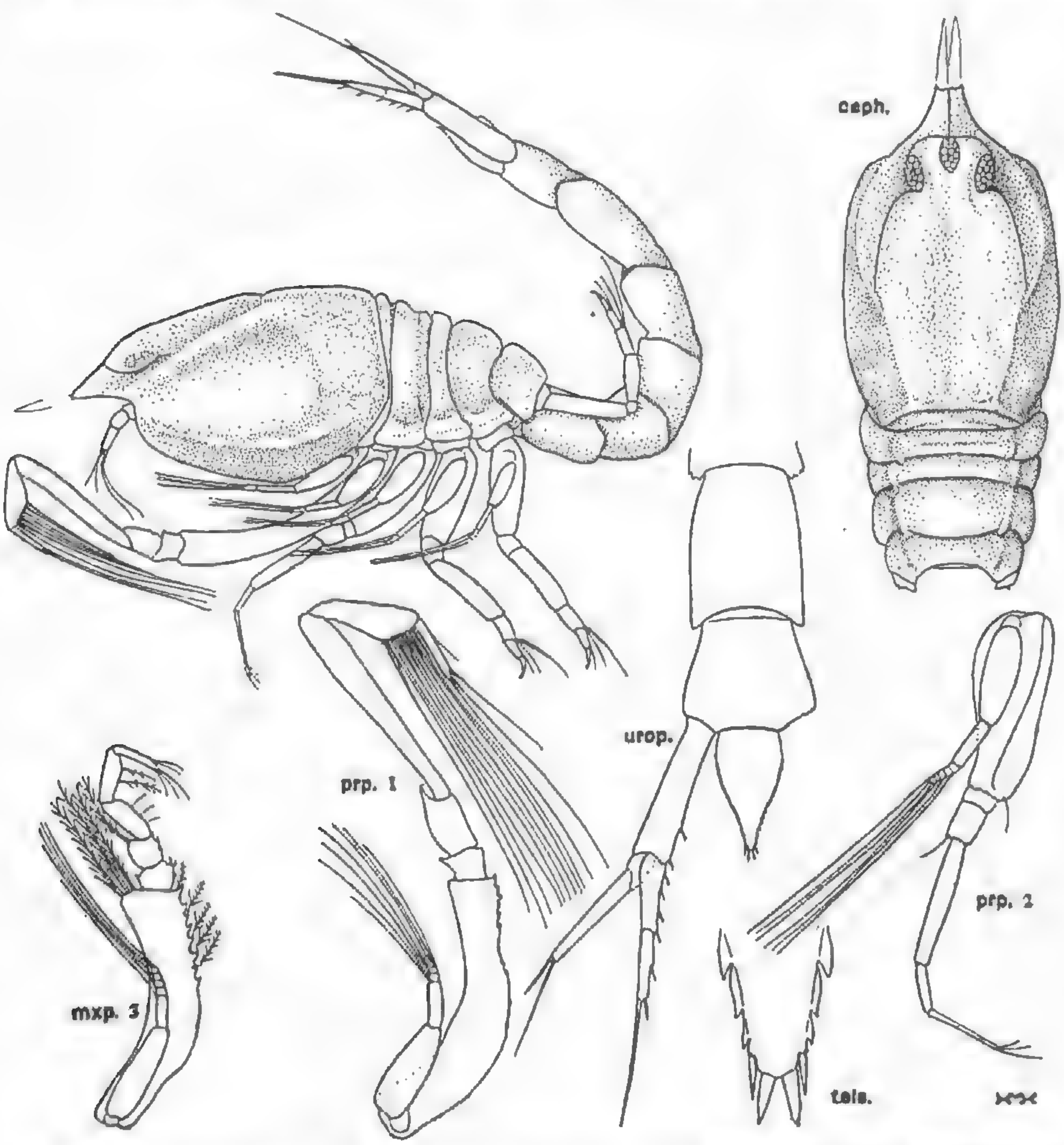

Fig. 11. *Gynodiastylis dilatata*, large-eyed male; lateral view and (ceph.) cephalothorax from above (× 42); mxp. and prp., third maxilliped, and first and second peraeopods; urop., uropod with fifth and sixth pleon somites, and telson (all × 56); tels., distal end of telson (× 280).

level of tip of the sharply pointed, curved dactylus. Fifth peraeopod a little shorter and more slender than fourth, with merus about equal in length to carpus and propodus together.

Peduncle of uropod one-third as long again as telson, as long as exopod, and with three short spines on distal half of inner margin; endopod a little longer than exopod, two-segmentate, the first joint with four spines on inner margin and a little longer than second, which has four short inner spines and a terminal spine

almost two-thirds as long as the ramus; longer of the unequal terminal spines of exopod a little longer than that of endopod.

Colour white. Length 3 mm.

Loc. New South Wales: Ulladulla, Brush Island, 45 fath., in fine silt on flat-head grounds (D. Rochford, Jan., 1945). Type in South Australian Museum, Reg. No. C. 2704.

Large-eyed male. The considerable differences between fully mature and sub-adult males in *Allodiastylis* and *Zimmeriana* gen. nov. lead one to place here a large-eyed adult male which agrees with the type in plan of sculpture and generally in the proportions of the appendages. It may be that two forms of mature male occur, or that this is the ultimate male form of the species. Unfortunately, in many of the Diastylids now dealt with females are taken far more frequently than are males, and the notes on this sex in *Gynodiastylis* and allied genera are based upon only a few specimens.

The following comparative details concern the large-eyed male in question (fig. 11).

The integument is semi-transparent, of almost glass-like brittleness; carapace with distinct reticulations, which are much larger on posterior portions of sides than elsewhere. Pleon with imbricate patterning.

Carapace one-third of total length of animal and not much wider than deep; the carinae are swollen, the lower lateral one in particular more in the nature of a fold surmounted by a carinate line; seen from the side the dorsum exhibits the same indentation at middle of length because of the tumid branchial regions and elevated mid-line of anterior half. Antero-lateral margin not at all excavate; antero-lateral angle rounded, with three or four insignificant blunt denticles, and inferior margin not serrate towards front. Pseudorostrum of same length as in type but decidedly downbent. Frontal lobe very large, with sutures distinct; ocular lobe swollen, more than one-third as wide as carapace, not quite twice as broad as long, constricted somewhat at base and with three big, colourless oval lenses, which exhibit distinct granular structure.

Pedigerous somites with dorso-lateral carinae swollen.

Telson with a pair of short terminal spines, flanked on each side by a single more slender spine; lateral margins distinctly serrate.

The second antennae are furnished with exceedingly dense sensory setae; the flagellum is not longer than peduncle.

Third maxilliped with basis more than one-third as long again as remaining joints together.

First and second peraeopods as in type excepting that the dactylus is definitely longer; that of the first is more than half length of propodus, that of second half as long again as propodus.

Second segment of endopod of uropod with only two spines on inner margin but with terminal spine almost as long as the whole ramus.

Length 2·75 mm.

Loc. New South Wales: off Eden, 30 metres, in coarse sand (K. Sheard, A. Trawl, Oct., 1943).

A juvenile male, 2·24 mm. in length, and with exopods of third and fourth peraeopods not fully developed, was taken by Mr. Sheard eleven miles off Eden, at a depth of 120 metres; while in many respects resembling the examples described above, this differs in having the first legs relatively longer, the carpus reaching for fully half its length beyond the apex of pseudorostrum. The endopod of the uropod is three-segmentate, the first joint not quite as long as second and third combined, and the second shorter than third. This is tentatively regarded as a young example of *dilatata*, but may represent another species.

GYNODIASTYLIS AMPLA sp. nov.

Female with developing marsupium. Integument calcified, opaque, with fine but distinct reticulate patterning.

Carapace two-sevenths of total length of animal and less than one-fourth as long again as pedigerous somites together; it is two-thirds as long as greatest width, which is equal to the depth. The most prominent features of the sculpturing are (1) a straight longitudinal ridge running back from below antennal tooth for greater part of length of carapace; (2) a pair of dorsal, longitudinal ridges

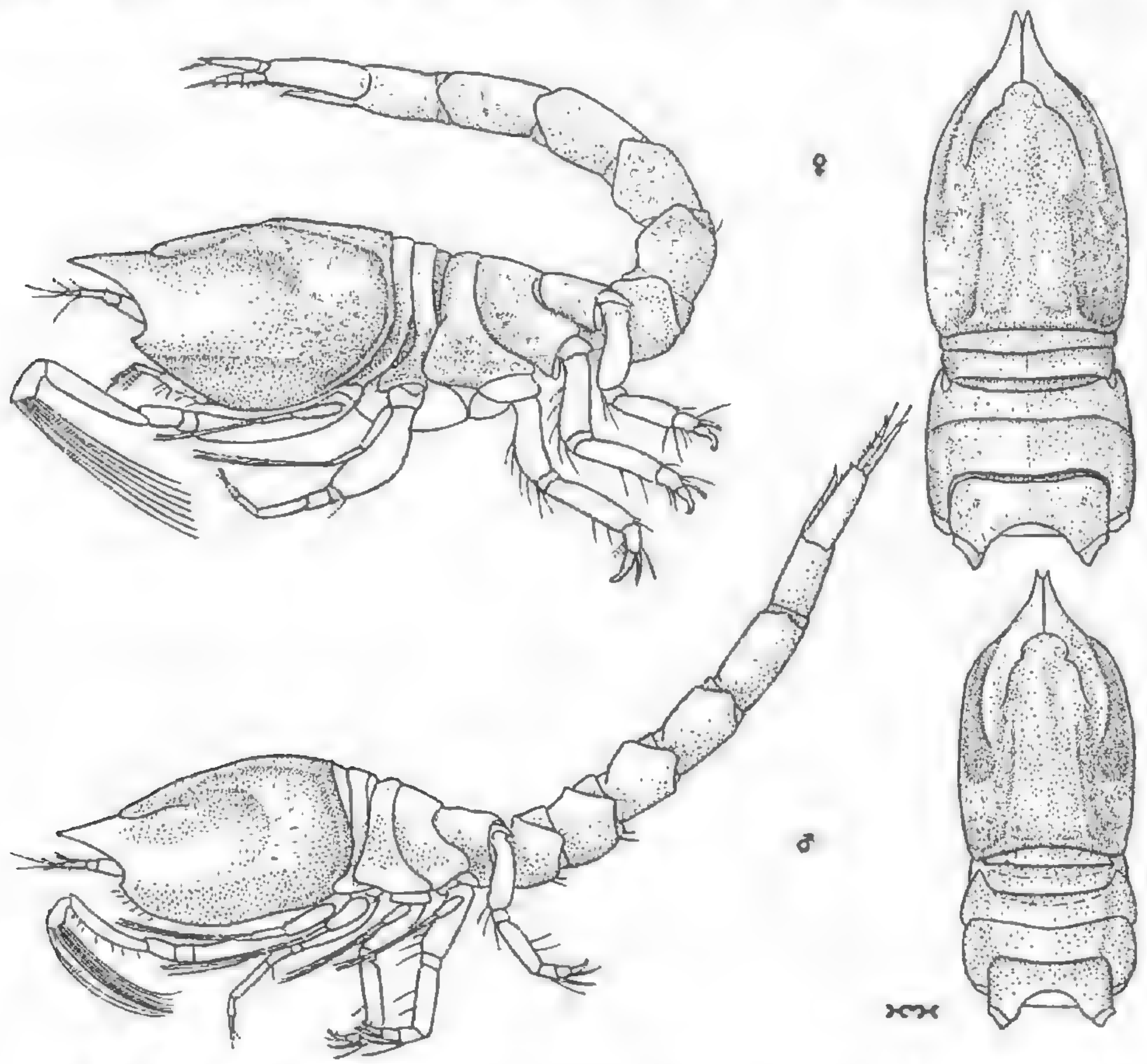

Fig. 12. *Gynodiastylis ampla*, type female and male; lateral views and cephalothorax from above (× 13½).

on posterior half, and meeting the raised posterior margin of carapace; (3) a depression on each side for anterior two-thirds of length: the upper edge of this hollow is marked by a fold which is most apparent when the carapace is viewed from above. There is a shallow concavity on each side of frontal lobe and the hinder parts of the sides are marked with faint pits, the interspaces forming incipient wavy ridges. Antero-lateral margin markedly concave; antennal angle acute, and margin below it finely serrate. Pseudorostrum long and pointed, the lobes meeting in front of ocular lobe for a distance equal to about one-fifth length of carapace, slightly gaping near apex. Sutures of frontal lobe distinct; ocular

lobe much wider than long, much less than half length of pseudorostrum, and with three pale lenses.

Pedigerous somites (like those of pleon) with shallow, irregular, large pittings; somites successively increasing in length dorsally; fourth and fifth as wide as carapace, the others narrower; pleural parts produced forwards on second

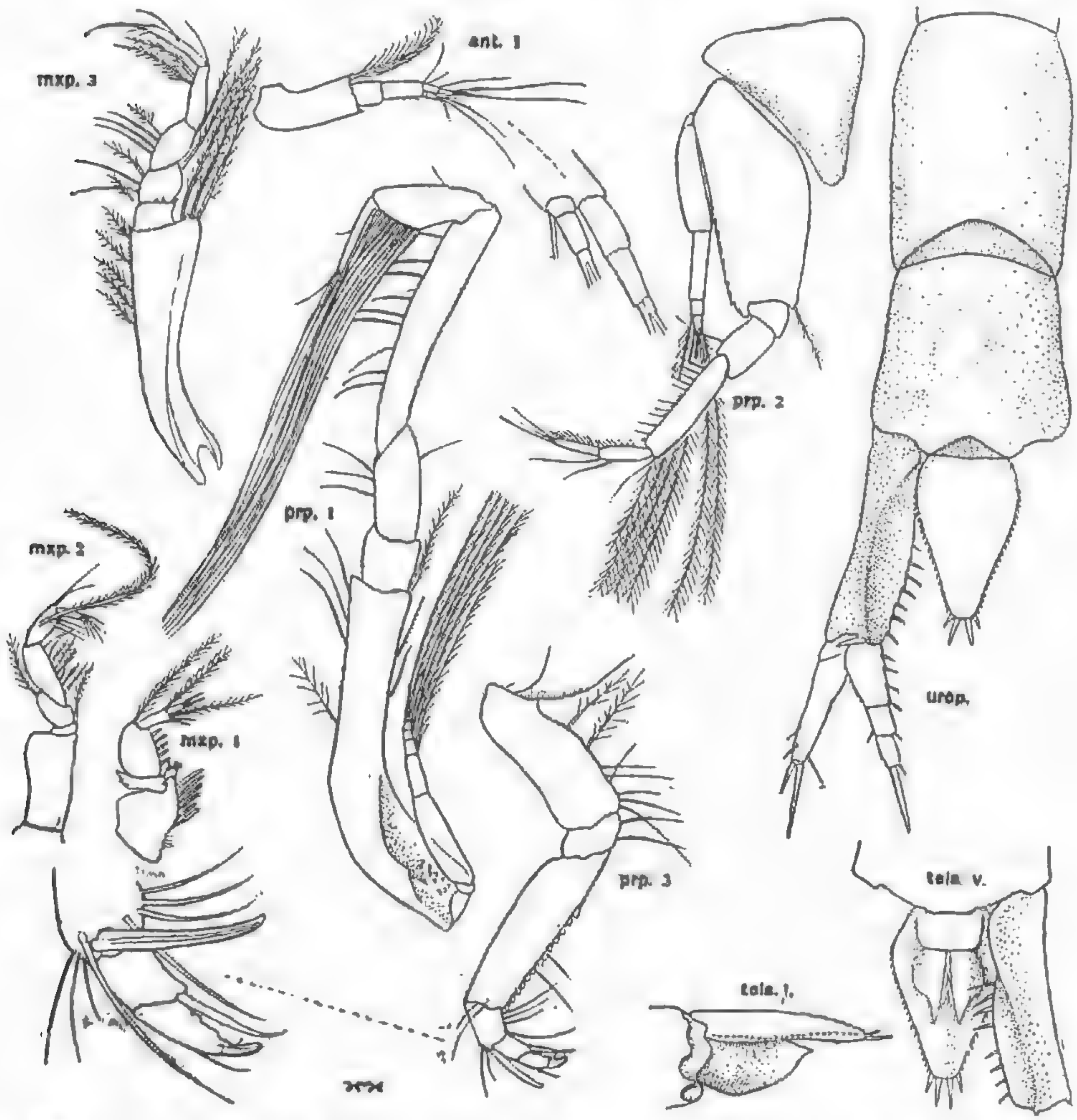

Fig. 13. *Gynodiastylis ampla*, type female; ant., first antenna (× 32; flagella, × 240); mxp., first to third maxillipeds (× 32); prp., first to third peraeopods (× 32; distal portion of third leg, × 75); urop., uropod with fifth and sixth pleon somites, and telson (× 32); tels. v., ventral view of telson and peduncle of uropod (× 32); tels. l., telson from the side (× 32).

and third somites, and backwards on third to fifth; fourth with a pair of indistinct longitudinal dorsal ridges.

Pleon equal in length to cephalothorax; somites depressed; fifth half as wide again as deep, one-third as long again as width and a little longer than sixth somite, which is little longer than wide, scarcely dilated posteriorly, and has the hinder margin medianly incised on the back; telson not very much shorter than sixth

somite, with lateral serrations fine, and with the two terminal spines flanked on each side by a shorter spine.

First antenna with first joint of peduncle long, projecting well in front of carapace, and longer than second and third joints together; second two-thirds as long as third, and equal in length to the two-jointed main flagellum, which is twice as long as accessory lash. Second antenna three-jointed, only about one-third as long as first pair.

First and second maxillipeds with basis short (see figures).

Third maxilliped elongate, its dactylus reaching forward to level of middle of length of pseudorostrum; basis narrow, slightly dilated distally and a little longer than rest of appendage; carpus, propodus and dactylus subequal in length, the last-named slightly the longest.

First peraeopod with merus reaching almost to level of antennal angle; basis distinctly more than one-half of rest of limb (when extended); propodus equal in length to merus and less than half as long as carpus; dactylus more than two-thirds as long as propodus; propodal and dactylar setae longer than ischium, merus and carpus together.

Basis of second peraeopod shorter than rest of limb; ischium relatively large; carpus nearly twice as long as merus, and longer than propodus and dactylus together; dactylus a little shorter than propodus and with distal setae longer than the joint.

Posterior peraeopods robust, as usual without trace of exopods, and with merus in all considerably longer than basis; carpus, propodus and dactylus short, together not much more than half length of merus; carpus with one of the distal setae enlarged to form a blunt-ended, stout spine, which reaches almost to tip of dactylus (fig. 13, bottom left); propodal seta stout (but more slender than above-mentioned carpal seta) tapering to the subacute apex.

Peduncle of uropod less than one-third as long again as telson, broad (less than four times as long as breadth) excavate longitudinally on interior face and with a row of eight or nine spines on inner edge; rami subequal in length; endopod three-fifths as long as peduncle, with its proximal joint equal in length to the other two subequal joints; first joint with four inner spines, the others each with one, and second with one at inner distal angle also; terminal spine half the length of ramus; exopod with two unequal terminal spines, one slightly longer than that of endopod.

Colour white. Length 9·3 mm.

Adult male. Carapace much as in female, but the antero-lateral angle is less emphasized, and the ocular lobe slightly larger; it is three-fourths as long again as pedigerous somites, which together are shorter than in the other sex. First pedigerous somite concealed on sides.

The pleon is one-tenth as long again as the cephalothorax. The lateral spines of the telson are almost as long as the terminal spines.

Exopods are present on the third maxilliped and first to fourth peraeopods; those of the last two pairs of legs are smaller than the others, but have peduncle and five-jointed flagellum, furnished with long plumose setae. The appendages otherwise are as in the female excepting for trivial differences; there are five instead of four spines on the first joint of endopod of uropod.

Length 8·2 mm.

Loc. New South Wales: Ulladulla, 75 metres (K. Sheard, A. Trawl, mesh 40, July, 1944). Types in South Australian Museum, Reg. No. C. 2654 and 2681.

This form is larger than any of the other species of the genus. The division of the endopod of the rather massive uropod into segments is much more distinctly marked than in some other members of the group having this ramus trisegmentate and the setae of the thoracic exopods are comparatively well-developed and strongly plumose.

GYNODIASTYLIS SUBTILIS sp. nov.

Female with developing marsupium. Integument well calcified, brittle, with surface smooth and somewhat polished.

Carapace robust, distinctly less than one-third of total length of animal, one-third as long again as pedigerous somites together, as wide as, and not much longer than, depth; dorsum boldly arched in lateral view, sides rounded and slightly sinuate as seen from above; the only sculpture is a curved furrow behind antero-lateral angle and the serrated inferior margin posterior to this angle. Antero-lateral margin shallowly and evenly concave; antero-lateral angle defined by the first of abovementioned serrations. Pseudorostral lobes truncate in front, the external apical angle forming a small tooth; they meet for a distance equal to about one-fifth length of carapace. Frontal lobe distinctly defined; ocular lobe rounded, short and broad with three pale lenses.

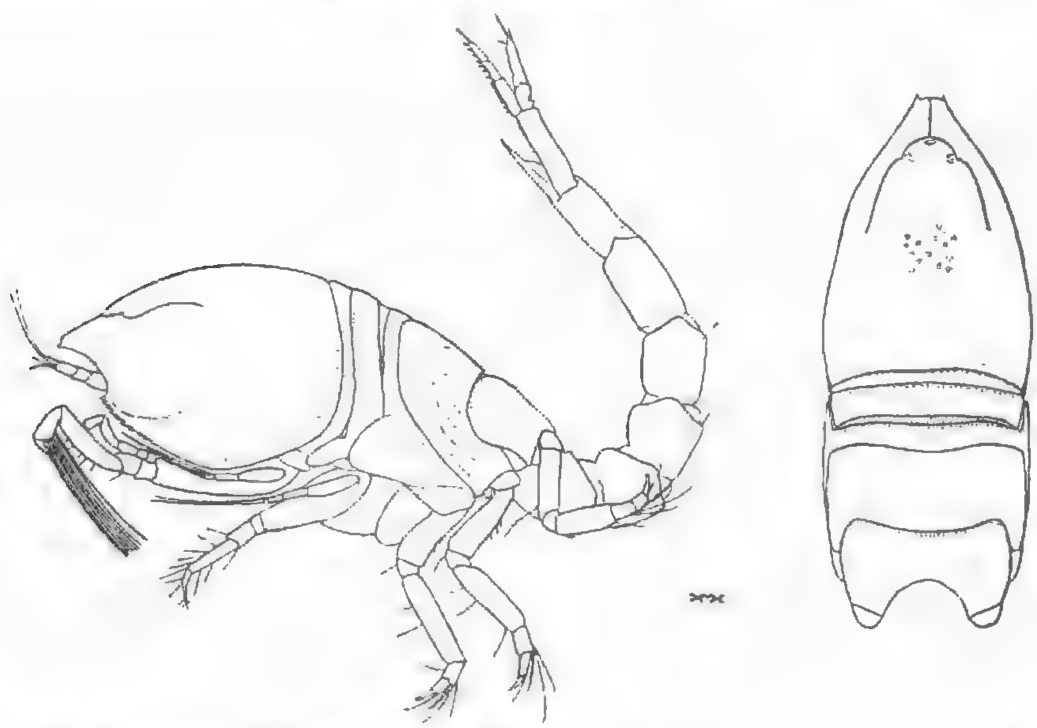

Fig. 14. *Gynodiastylis subtilis*, type female; lateral view and cephalothorax from above (× 25).

Anterior pleural portions of second pedigerous somite produced forwards as a narrow lobe; third with similar but much deeper anterior lobe and also extended well backwards; the second and third legs are distinctly separated (probably widely separated in ovigerous female); fourth and fifth somites much longer dorsally than the others.

Pleon a little longer than cephalothorax; fifth somite one-third as long again as sixth, which is as wide as long and twice as long as deep; telson almost as long as sixth somite; tapering, but not markedly narrowed to the rear, laterally serrate, rounded above, and with a post-anal portion equal to about half the length of proximal part; there is a pair of stout apical spines, flanked by a similar spine on each side; at third fourth of length there is a further lateral spine on the right side and nearly opposite this, on the left, a bristle.

First antenna with third peduncular joint not much longer than second; the two-jointed accessory flagellum is half as long as the main lash.

Third maxilliped wide, the basis more than one-third as broad as long, and equal in length to rest of appendage; ischium and merus shorter than any of the other joints, but merus unusually wide, expanded externally; propodus a little longer than carpus and half as long again as dactylus.

First peraeopod short, the carpus not quite reaching level of apex of pseudo-rostrum; basis almost as long as rest of limb and with a couple of inner distal spines; carpus long, more than half length of basis, and more than twice as long as the short and broad propodus; dactylus with long terminal setae but itself very

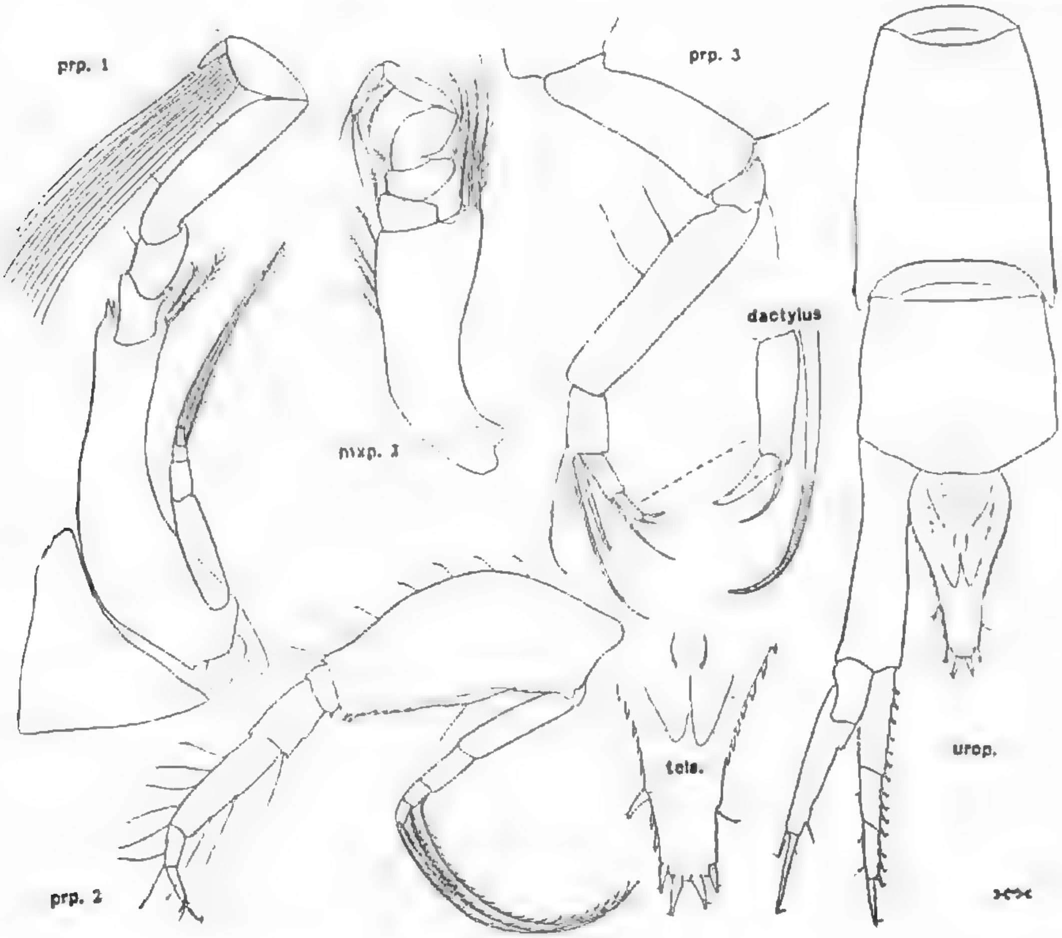

Fig. 15. *Gynodiastylis subtilis*, type female; mxp. and prp., third maxilliped and first to third peraeopods (× 60; propodal seta, and dactylus with its claw and seta, × 230); urop., uropod with fifth and sixth pleon somites, and telson, ventral aspect (× 60); tels., ventral view of postanal part of telson (× 115).

short, not much more than one-third as long as propodus, which bears a dozen setae, like those of dactylus very long.

Second peraeopod robust; basis serrate on inner edge and as long as rest of limb; ischium distinct, with a small inner spine; carpus two-thirds as long again as merus, which is as long as the short, subequal, propodus and dactylus together; marginal setae of the limb are long but terminal setae of dactylus are short.

Third to fifth peraeopods relatively long, the third and fourth exceeding the second leg in length; the merus is twice as long as carpus and propodus together; the longest distal carpal seta, immediately preceding the usual shorter and stouter seta, extends well beyond apex of dactylus, as does also the propodal seta; dactylus with separated claw, at base of which is a seta (see dactylus, in fig. 15).

Uropod with the unarmed peduncle fully as long as telson, and slightly exceeding endopod in length; exopod little shorter than endopod, with terminal spine stout, less than half as long as the ramus and three times as long as an outer subterminal spine; endopod composed of three joints, the first equal to combined length of the other two, which are subequal in length; inner margin of endopod unusually well endowed with spines for female of the genus, there being seven, four and three on the respective joints; terminal spine short and stout, not exceeding last joint in length.

Colour milky white. Length 4·4 mm.

Loc. New South Wales: Ulladulla, 75 metres (K. Sheard, A. Trawl, June, 1944). Type in South Australian Museum, Reg. No. C. 2671.

This species bears a general resemblance to *polita* but is at once distinguished by the shorter first peraeopod, the considerable differences in the other appendages and above all by the very different telson.

GYNODIASTYLIS CARINIROSTRIS sp. nov.

Ovigerous female. Integument lightly calcified, not at all brittle, but tough and not easily torn.

Carapace one-third of total length of animal and barely longer than pedigerous somites together; it is almost twice as long as deep; from above it is subtriangular, widest near posterior end, where it is distinctly wider than deep; pseudorostral

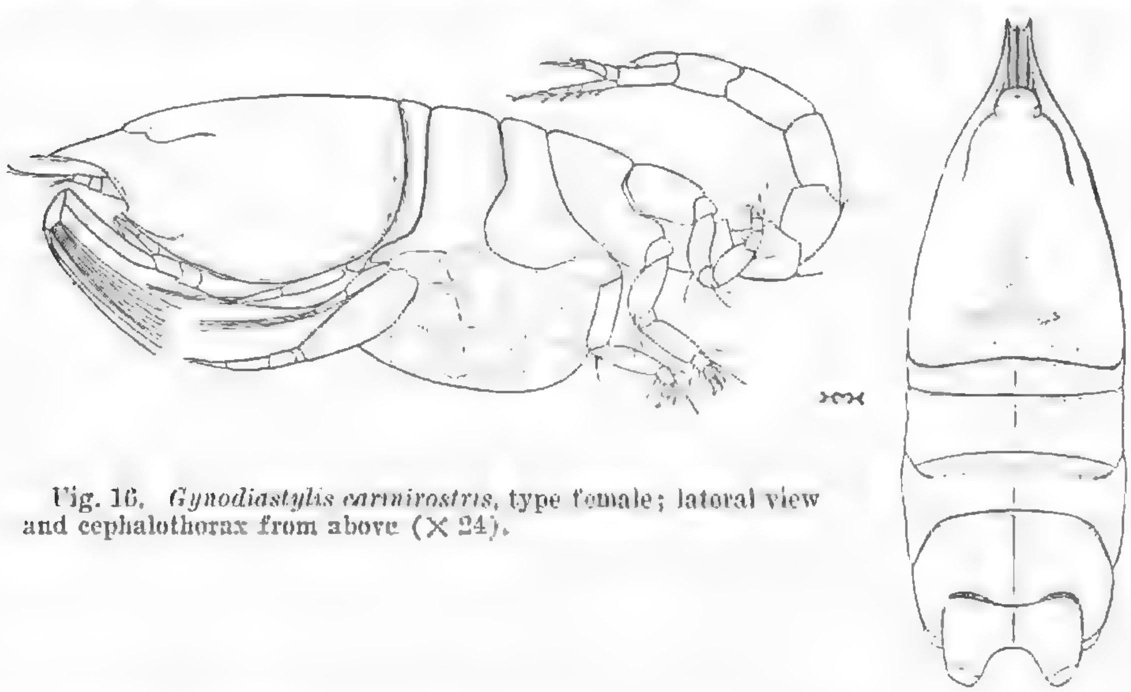

Fig. 16. *Gynodiastylis carinirostris*, type female; lateral view and cephalothorax from above (× 24).

lobes each a sharp, longitudinal, dorsal carina running from apex to ocular lobe; posterior half of carapace with a faint median dorsal depression, flanked at hinder end by a pair of pits; sides without sculpture except for a very shallow, short, curved furrow extending back from antero-lateral angle; antennal notch distinct and angle acute. Pseudorostral lobes narrow, acute anteriorly, meeting for a distance equal to fully one-fifth of length of carapace. Ocular lobe rounded, wider than long, with three colourless corneal lenses.

Pedigerous somites smooth, the first much shorter than any of the others which do not differ markedly in length; pleural parts of second and third expanded for-

wards, and of third and fourth markedly backwards, the coxae of second and third peraeopods very widely separated; as on carapace there are a few pellucid dorsal spots and each somite has a median dorsal wavy line, absent on carapace.

Pleon barely longer than carapace; fifth somite not much longer than sixth, which is considerably depressed, a little wider than long; telson short (about three-

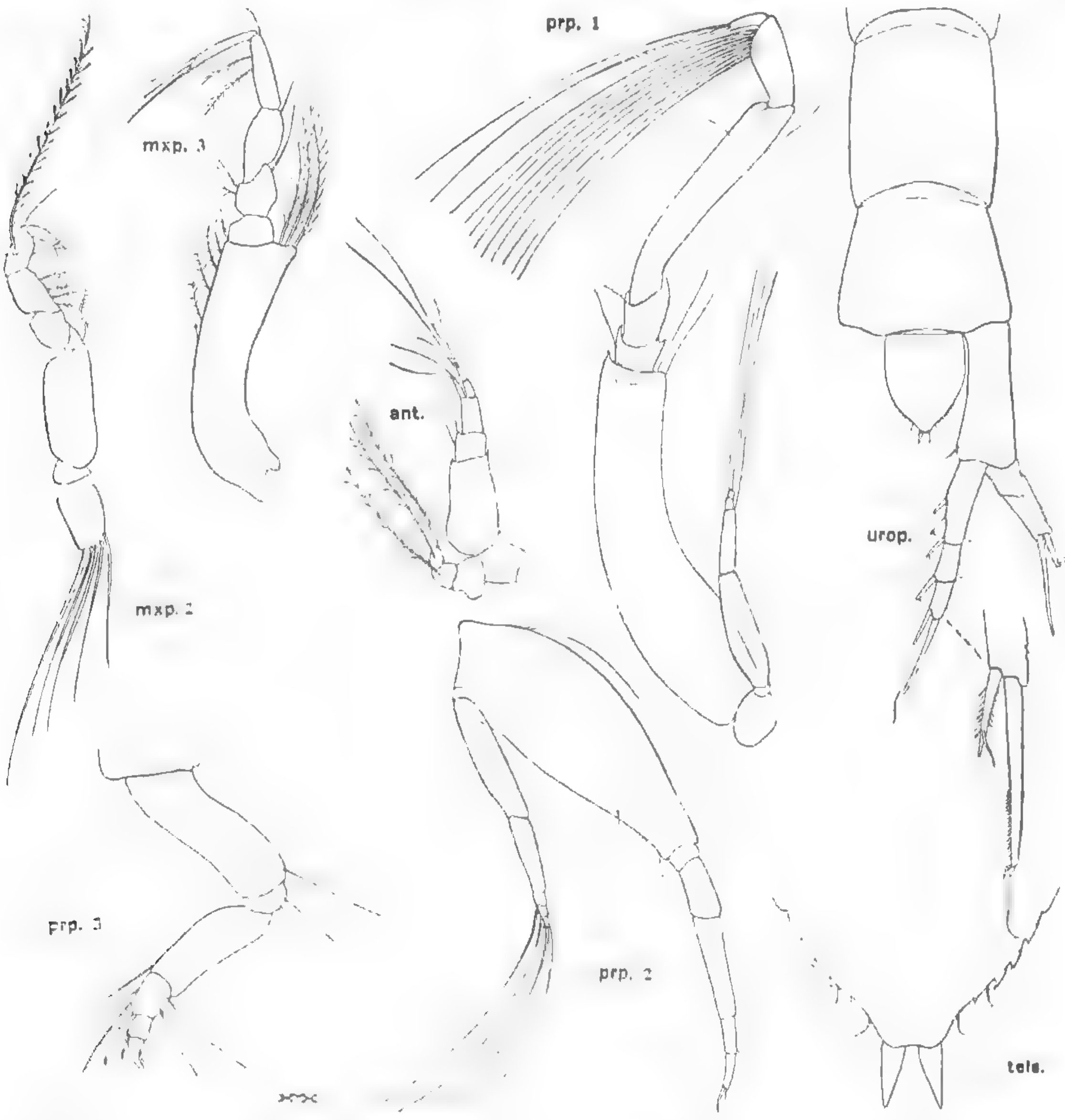

Fig. 17. *Gynodiastylis carinirostris*, paratype ovigerous female; ant., first and second antennae (× 56); mxp., second and third maxillipeds (× 56); prp., first to third peraeopods (× 56); urop., uropod with fifth and sixth pleon somites, and telson (× 56; spines of endopod, × 126); tels., distal end of telson (× 286).

fourths as long as sixth somite), subconical, with two short, stout apical spines, two pairs of lateral bristles and with lateral serrations in distal third; there is no distinct post-anal portion.

First antenna with first joint of peduncle as long as rest of appendage including flagellum; second joint shorter and stouter than third. Second antenna three-jointed with long plumose setae.

Mandible with nine or ten spines.

Third maxilliped slender, elongate, the propodus reaching quite to antennal angle; unarmed but with the usual setae; basis barely equal in length to remaining joints together; carpus, propodus and dactylus equal in length, each almost as long as ischium and merus together

First peraeopod short, the carpus not reaching level of apex of rostrum; basis subequal in length to rest of limb; carpus elongate, two-thirds as long as basis and three times as long as the short propodus, which is furnished with a fan of nine or ten long setae; dactylus very short, less than half length of propodus, with a pair of long distal setae.

Second peraeopod with the stout basis not much longer than remaining joints together; ischium distinct, relatively large; carpus more than half as long again as merus; propodus and dactylus subequal in length, each not much more than one-third as long as carpus; terminal dactylar setae short, one stout.

Third to fifth peraeopods all approximately same size; the broad merus is about twice as long as carpus and propodus together; dactylus short, stout and blunt.

Peduncle of uropod as long as sixth pleon somite, two and one-half times as long as wide, with a short inner spine near distal end; endopod a little longer than peduncle; three-jointed, the first segment fully as long as second and third joints together and with three inner spines; the last two each have one inner spine, that of third subdistal; terminal spine as long as first joint; exopod stout and short, only as long as first joint of endopod, and with the longer of its two terminal spines as long as the ramus.

Colour white. Length 4·7 mm.

Loc. New South Wales: Botany Bay, off Kurnell, 20 feet (W. Fairbridge, Aug., 1943). Type in South Australian Museum, Reg. No. C. 2669.

Several females with eggs or embryos in the marsupium.

GYNODIASTYLIS TRUNCATIFRONS Hale.

Gynodiastylis truncatifrons Hale, 1928, p. 43, fig. 13–14 and 1937, p. 65.

Ovigerous female. Re-examination of the type shows that in that example the uropods have been mutilated during life; normally the endopod in the female is fully as long as the peduncle and is three-, not two-jointed, with the first joint longer than second, which is barely longer than third; the longest terminal spine is fully three-fourths as long as the ramus and the joint bears respectively three, two and two short inner spines; exopod as long as the two proximal joints of endopod.

The antero-lateral angle is emphasized by a slender spine, posterior to which the inferior margin bears a row of similar teeth.

An ovigerous female from Sellick's Reef, South Australia, is only 3·7 mm. in length, only half as long as the type.

A rather extreme range in size of ovigerous females associated in the same situation is found also in *similis* Zimmer

Adult male. An adult male from Memory Cove, South Australia, is nearly 5 mm. in length; exopods are well developed on the first four pairs of peraeopods.

Some examples about 3·2 mm. in length are available from New South Wales (4 miles off Eden, 70 metres, K. Sheard, Oct., 1943); one of these is here illustrated. The antennal spine, and the spines posterior to it are shorter than in the females and the antero-lateral portion of the carapace is denticulate above the curved lateral groove. The telson bears a pair of apical spines, flanked by a similar spine on each side, all being relatively larger than in the female.

The first antenna has the first joint of peduncle longer than second and third together, and second shorter than third; the slender three-jointed accessory flagel-

lum is half as long as the main lash, which is apparently four-jointed. The eleven-jointed flagellum of the second antenna is as long as the peduncle.

The first peraeopod has the carpus a little more elongate than in the female and as in the latter the ischium bears two distal spines, and the merus one or two.

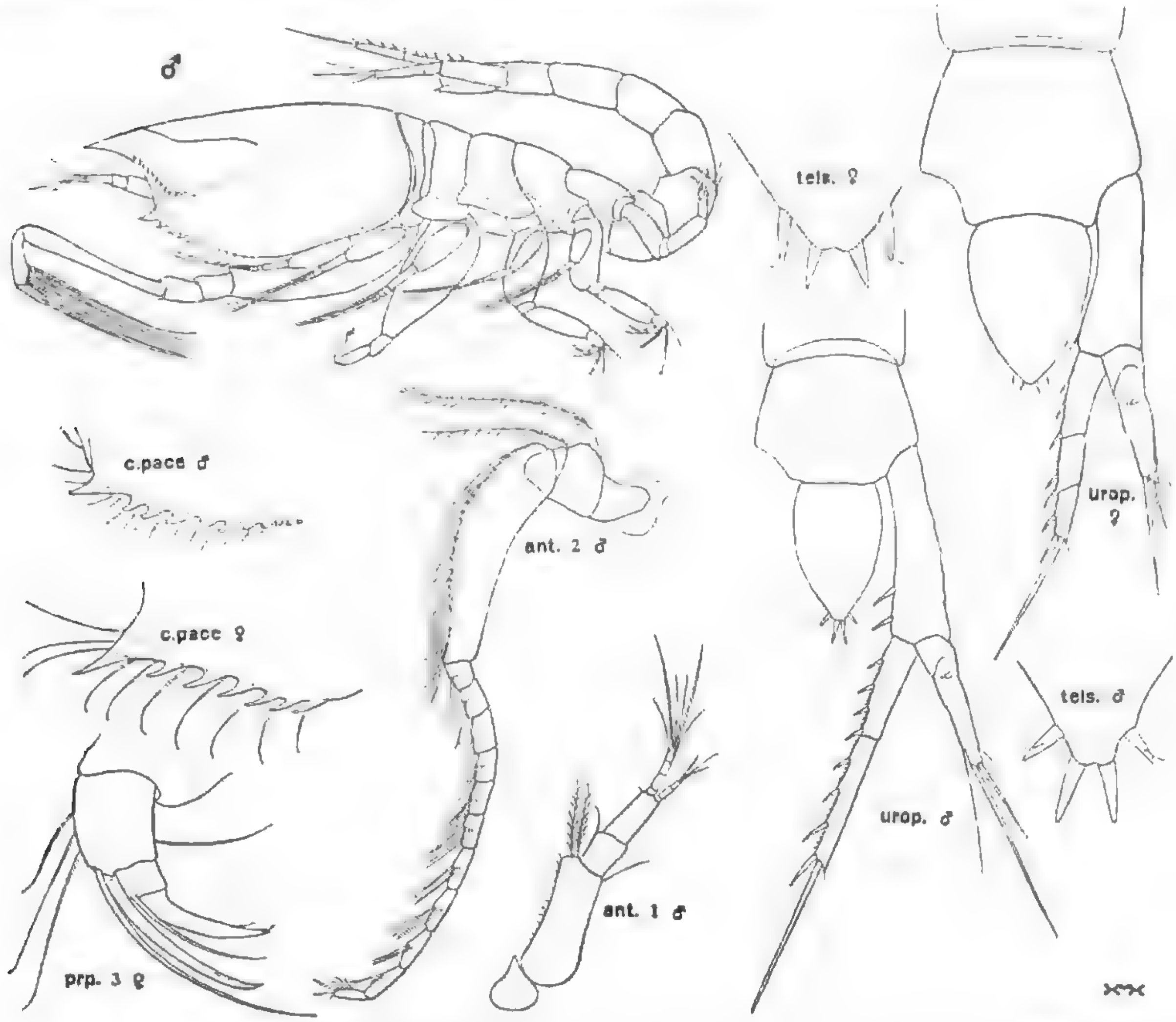

Fig. 18. *Gynodiastylis truncatifrons*, adult male (3·2 mm., New South Wales) and ovigerous female (3·7 mm., South Australia); lateral view of whole animal (× 30); c. pace, antero-lateral angle and inferior margin of carapace (× 72); ant., first and second antennae (× 72); prp. 3, distal joints of third peracopod (× 120); urop., uropod with fifth and sixth pleon somites, and telson (× 72); tels., distal end of telson (× 240).

The endopod of the uropod is one-fifth as long again as the peduncle; it is divided into only two joints, each of which bears four inner spines; the first joint is about three-fourths as long as second, the long terminal spine of which is longer than its joint; exopod not much more than half as long as endopod, its longest terminal spine longer than ramus and longer than that of endopod.

GYNODIASTYLIS POLITA sp. nov.

Ovigerous female. Integument smooth and polished, the only sculpture being a faint, curved depression on side of carapace, running back from antennal angle to about middle of length, and not margined by folds or ridges.

Carapace less than one-third of total length, and two-thirds as long again as deep; seen from above it is subtriangular in shape, tapering to the front and broad

at the rear, where it is considerably wider than deep. Antero-lateral margin below pseudorostrum perpendicular, not at all concave; antero-lateral angle with a tiny tooth, behind which are two similar denticles. Pseudorostrum nearly one-fifth of total length of carapace; each lobe is narrowly truncate in front with the upper (or inner) distal angle produced as a minute tooth which rests against its fellow of the opposite side. Frontal lobe moderately large, distinctly defined; ocular lobe rounded, more than twice as wide as long, and with three pale lenses.

Pedigerous somites together about three-fourths as long as carapace; successively increasing in dorsal length to fourth, which is longer on mid-line of back than fifth; pleural parts of second produced well forwards and overlapping those of first; third somite expanded in front on the side (where it overlaps the second) and also much to the rear, the second and third legs being widely separated; it is completely fused with the fourth somite on the back and dorso-laterally, but not so

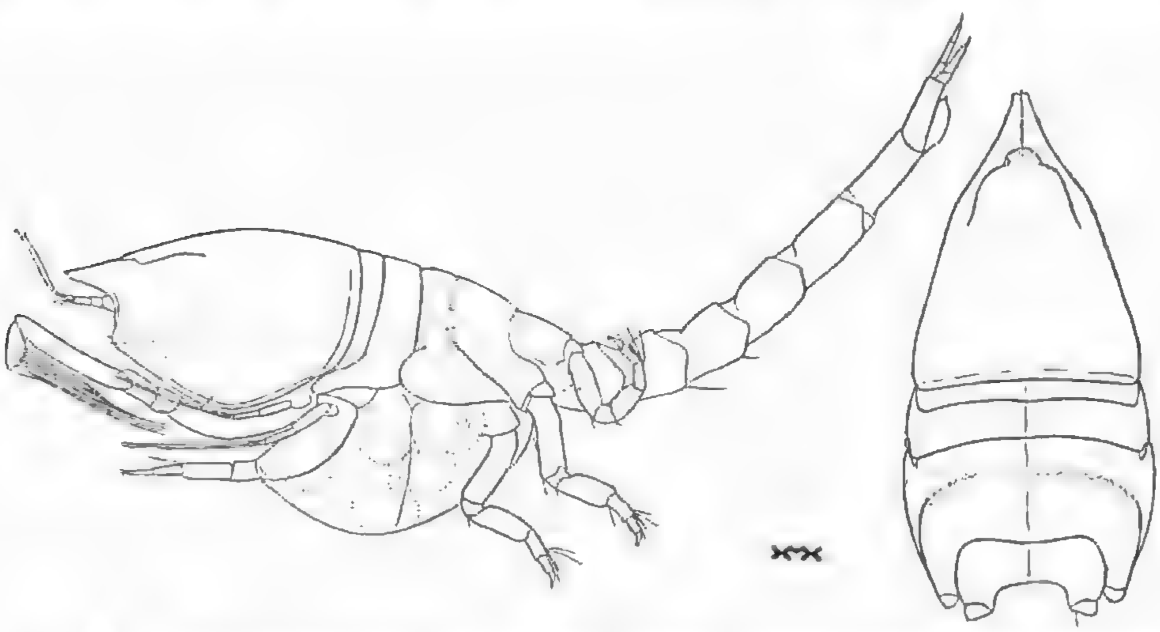

Fig. 19. *Gynodiastylis polita*, type female; lateral view and cephalothorax from above (× 22).

completely on lower part of sides; there is the fine median longitudinal line on all somites (apparent in several species), but no real carinae or folds.

Pleon shorter than cephalothorax, not depressed; the fifth somite is half as long again as wide and is one-fifth longer than the sixth somite which is little broadened posteriorly, where it is as wide as long; telson about three-fourths as long as the fifth somite, plump, smooth and rounded with very short post-anal part; the apex bears a pair of short, stout spines, a little anterior to which, on each side, a small bristle is set in a tiny incision.

First antenna with proximal joint of peduncle a little shorter than second and third together; third more than half as long again as second; flagellum two-jointed, longer than second peduncular segment; accessory flagellum elongate, nearly as long as first joint of main lash and apparently single-jointed. Second antenna with three segments not differing much in length, the setae of the last two as long as first antenna.

Mandible with nine or ten spines in the row.

Third maxilliped with palp elongate, with the appendage extended the propodus reaches to level of apex of pseudorostrum; basis about two-thirds as long as rest of limb, little expanded distally; merus somewhat expanded, carpus longer

than ischium and merus together, and fully as long as propodus, which is little longer than dactylus.

First peraeopod robust, the carpus reaching beyond apex of pseudorostrum; basis about half as long as remaining joints together; carpus very long, fully two and one-half times the length of the propodus, which is broadened in distal third,

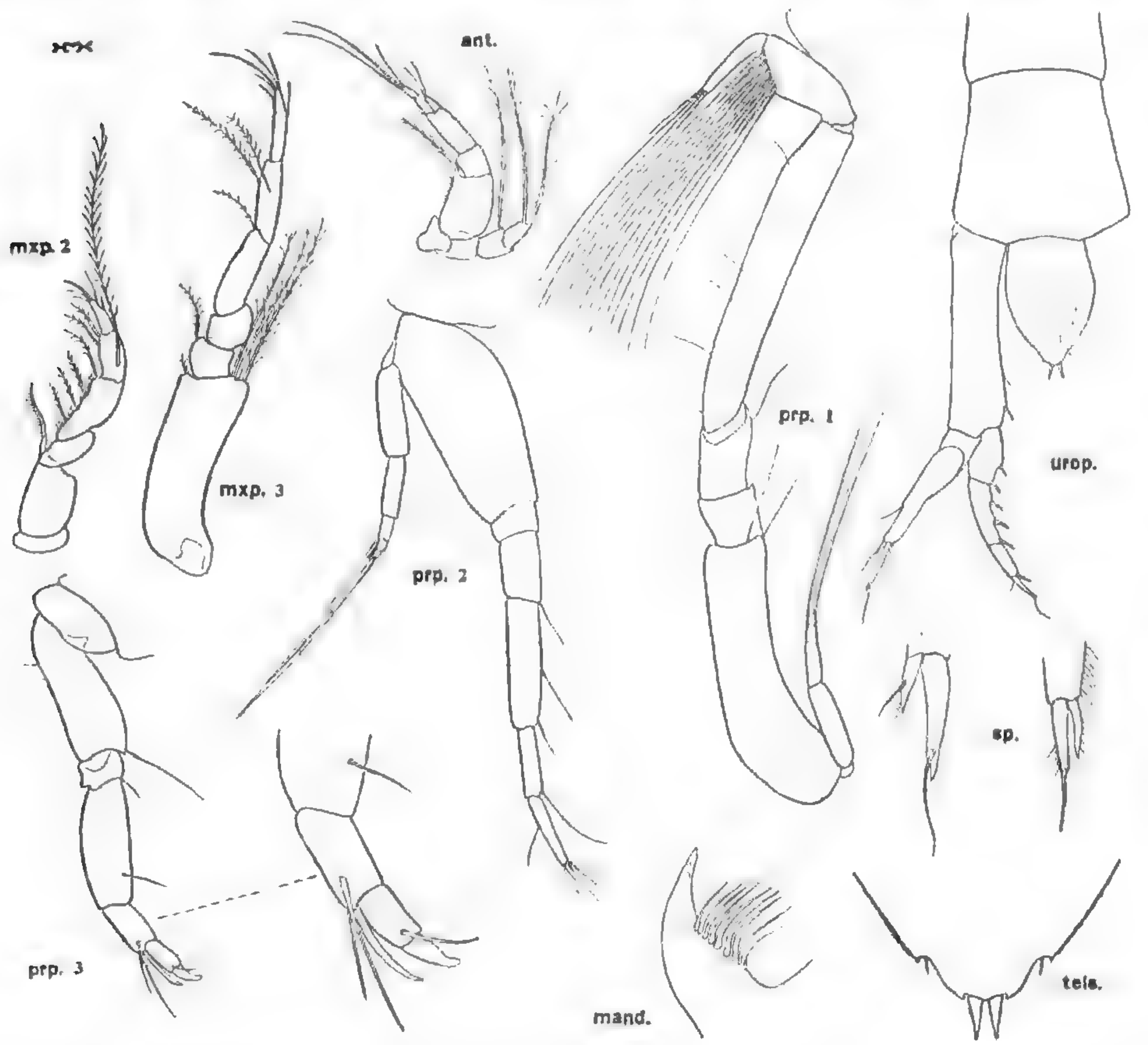

Fig. 20. *Gynodiastylis polita*, paratype non-ovigerous female; ant., first and second antennae (× 64); mand., distal portion of mandible (× 120); mxp., second and third maxillipeds (×64); prp., first to third peraeopods (× 64; distal joints of third leg, × 120); tels. and sp., distal end of telson and terminal spines of rami of uropod (× 240). urop., Uropod of type ovigerous female, with sixth pleon somite and telson (× 55).

where are seated a dozen very long inner setae; dactylus two-thirds as long as propodus and with long terminal setae.

Second peraeopod with basis shorter than rest of limb; ischium not distinctly separated off from basis; carpus more than half as long again as either merus or propodus, the latter almost equal in length to the dactylus.

In the third to fifth peraeopods the basis is not or barely longer than ischium and merus together; the merus in third and fourth pairs is little more than twice as long as carpus; one of the distal carpal setae is much stouter than the others and does not reach quite to the tip of the short, stout and blunt dactylus; propodal seta slender, reaching to tip of dactylus.

Peduncle of uropod more than half as long again as either exopod or telson, with a spine and a seta near distal end of inner margin; endopod curved like a bow, a little longer than exopod and composed of three segments, the second somewhat longer than first and nearly twice as long as third; the suture between second and third segments is not very distinct; the joints bear respectively two, three and one inner spines, the last subterminal; the terminal "spines" (really composite setae) of both exo-and endopod are stout, and are short unless one includes in their length the slender setal distal portion which emerges from the wide spine-like, proximal part (see fig. 20, sp.).

Colour white. Length 4·7 mm.

Female with developing marsupium. The carapace is relatively a little longer (one-third of total length) than in the ovigerous female and is not widened posteriorly, but is suboval in shape and not as wide as deep; the same little distal point is present on the pseudorostrum. Pedigerous somites together are not much more than half as long as the carapace; the third and fourth are not ankylosed to the same degree, while the second and third somites are less expanded on the sides, so that the third legs are separated from the second by a space little greater than that between the others; the pedigerous somites as a whole are, of course, not nearly so broadened as shown in fig. 19. The pleon is as long as the cephalothorax; its fifth somite is only one-fourth as long again as wide, but the telson is as in the adult.

At this stage the appendages differ in no important detail from those of the ovigerous female, excepting that the peduncle of the uropod does not reach much beyond end of telson, and is barely longer than the rami, while the endopod of this appendage has two, instead of three, inner spines on second joint.

Length 2·9 mm.

Similar differences occur between subadult and ovigerous females of other members of the genus and are here given because some species, owing to lack of other material, are described from females not fully mature.

Loc. New South Wales 11 miles off Eden, 120 metres (subadult female, K. Sheard, A. Trawl, Jan., 1943); 5 miles off Eden, 60 metres, on mud (type loc., K. Sheard, submarine light, Dec., 1943); 4 miles off Port Hacking, 80 metres, on mud (K. Sheard, A. Trawl, May, 1944); Ulladulla, Brush Island, 45 fath., in fine silt on flathead grounds (D. Rochford, Jan., 1945). Type in South Australian Museum, Reg. No. C. 2712.

The male was not taken at any of the above localities. In general the species resembles the smaller *hartmeyeri* Zimmer (1914, p. 187, fig. 14) from Western Australia but differs in the armed telson and in the much longer first peraeopod, the more prominent and dentate antero-lateral angle of carapace, etc.

GYNODIASTYLIS AMBIGUA sp. nov.

Ovigerous female. A.—(type). Integument smooth, thin but calcified.

Carapace less than one-third of total length of animal and equal in length to pedigerous somites together; twice as long as deep; seen from above it is subtriangular in shape, widest posteriorly, where it is half as broad again as depth; dorsum with an obscure median ridge on anterior half, not greatly arched as seen from the side. Antero-lateral margin concave; antero-lateral angle with two small teeth. Pseudorostral lobes narrow anteriorly and excavate, meeting for a distance equal to less than one fourth of length of carapace. Frontal lobe well defined; ocular lobe subtriangular, with three faintly delineated lenses.

Second and fourth pedigerous somites longer dorsally than any of the others; pleural parts of second produced forwards, that of third somewhat expanded

in front and much produced to the rear, the second and third peracopods being very considerably separated.

Pleon depressed, about one-third as long again as carapace; fifth somite barely longer than sixth, which is a little longer than broad; telson subcordate as seen from above, two-thirds as long as sixth somite; a short distal portion is post-anal with a pair of apical spines and near them on each side a lateral spine of about the same size; lateral serrations small.

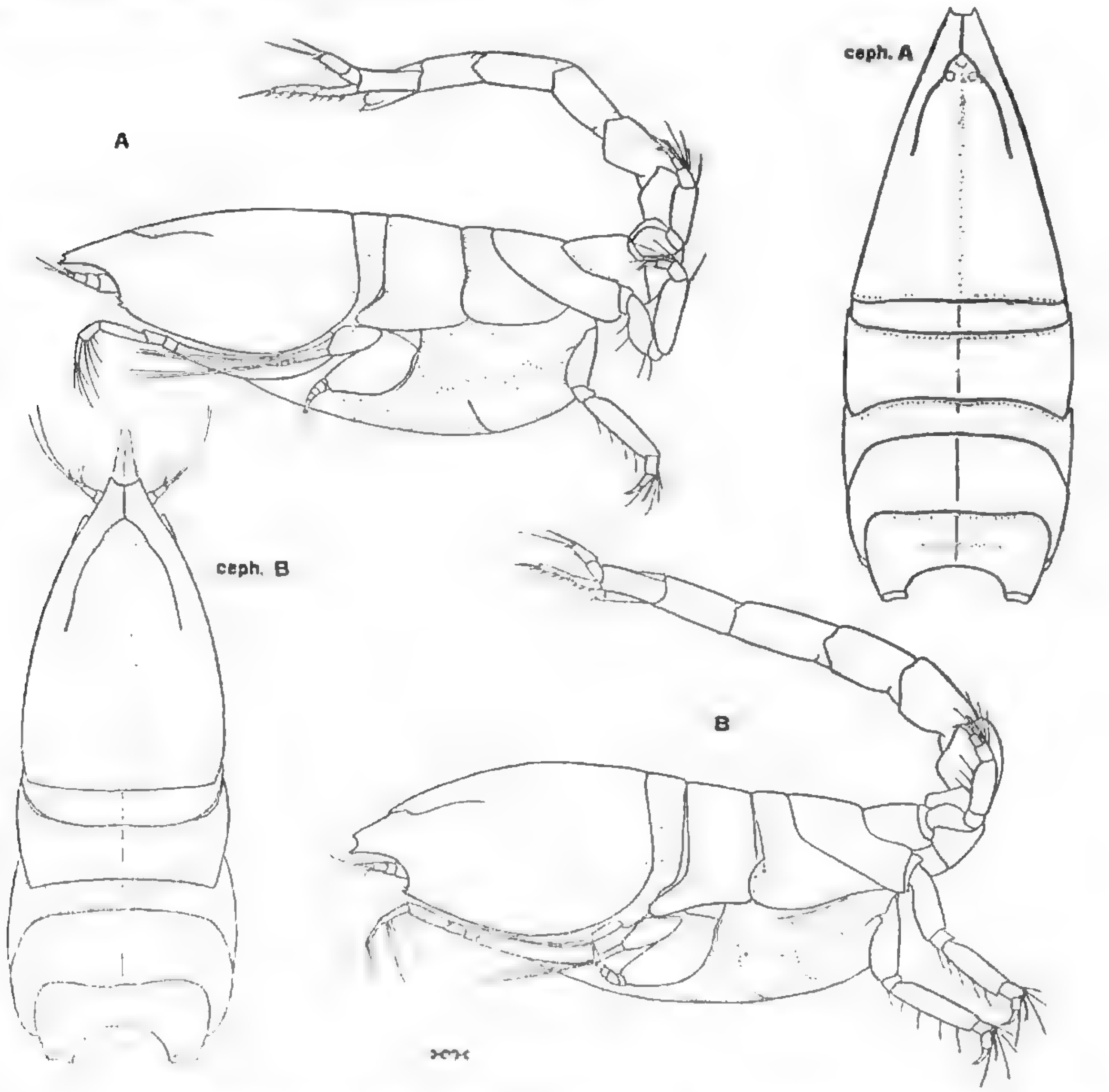

Fig. 21. *Gynodiastylis ambigua,* ovigerous females; lateral views, and (ceph.) cephalothorax from above, of type A– and variety –B (× 30).

First antenna with first joint of peduncle longer than second and third together; flagellum two-jointed and accessory lash small.

Basis of third maxilliped three-fourths as long again as rest of limb; remaining joints not differing markedly in length.

First peraeopod short, barely reaching past apex of pseudorostrum when extended, the carpus reaching a little beyond level of antennal angle; basis three-fourths as long again as rest of limb, with a slender tooth at inner apical angle; propodus about three-fourths as long as carpus, a little longer than dactylus and about as long as merus; propodal setae sparse and not very long.

Second peraeopod with exopod (not including setae) as long as basis, which is almost three times as long as rest of limb; ischium distinct, not much shorter than the abbreviated merus and carpus; propodus a little longer than carpus and about two-thirds length of dactylus.

Third and fourth peraeopods longer than second; merus stout, longer than basis and more than twice as long as carpus and propodus together; the most distal of the carpal setae is short, claw-like, and much stouter than the other setae of this joint and than the propodal seta, which reaches well beyond tip of dactylus; fifth peraeopod about as long as second.

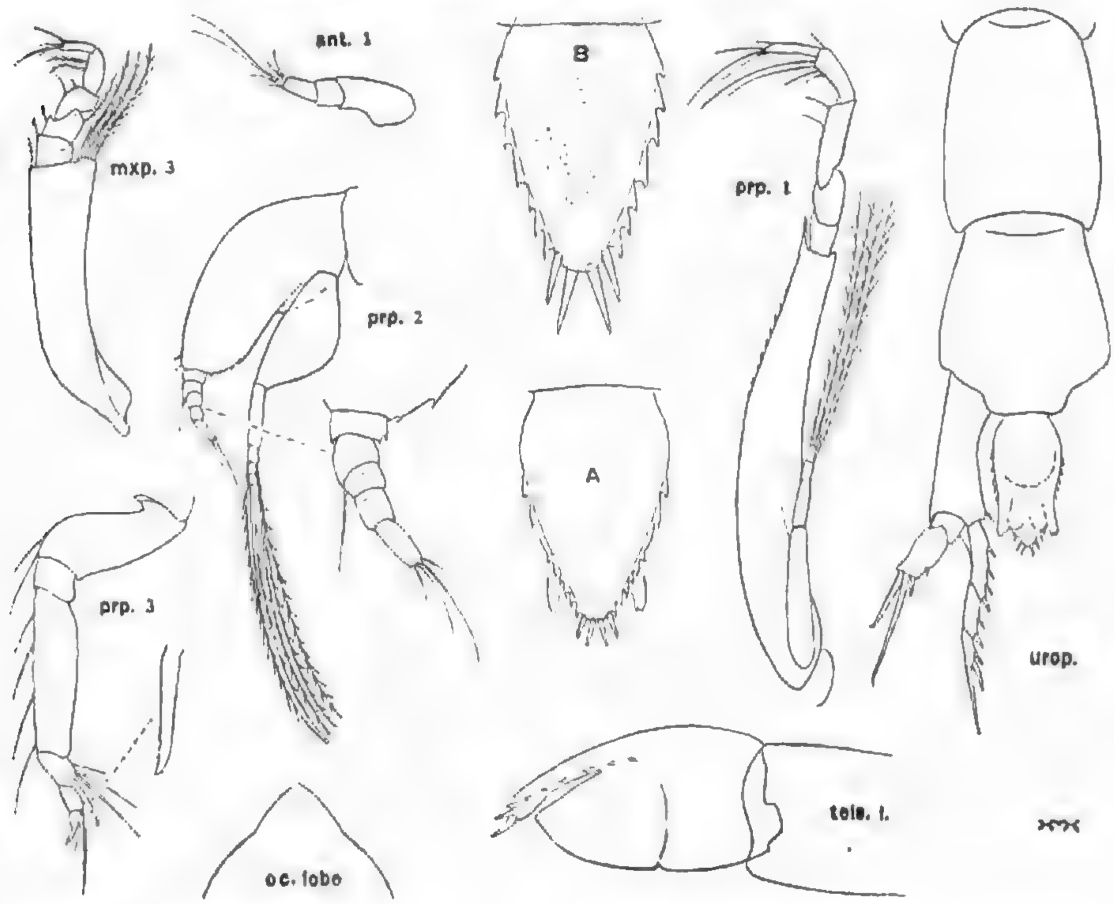

Fig. 22. *Gynodiastylis ambigua*, paratype female; oc. lobe and ant., ocular lobe and first antenna (× 56); mxp. and prp., third maxilliped and first to third peraeopods (× 56; distal joints of second leg and carpal seta of third, × 125); urop., ventral aspect of uropod with fifth and sixth pleon somites, and telson (× 56); tels. l., lateral view of telson (× 125). A, Telson of type female (× 125). B, Telson of variety (× 125).

Peduncle of uropod stout, about as long as telson, with one subdistal spine on inner margin; endopod equal in length to peduncle and twice as long as exopod, three-jointed, the first joint as long as second and third together; inner margin with four spines on first joint, two on second and two on third, the last subdistal and longer and stouter than the others; terminal spine half as long as ramus; exopod with three unequal terminal spines, the inner very short, the longest much longer than ramus and longer than terminal endopodal spine.

Colour white. Length 3·5 mm.

Loc. New South Wales: Jibbon Station, 70 metres, on sand (type female loc., K. Sheard, A. Trawl Station 9. Aug., 1943); 4 miles off Eden, 70 metres, in

silt (K. Sheard, Oct., 1943). Type in South Australian Museum, Reg. No. C. 2674.

Ovigerous female. B.—(robust form). One of the examples from the type locality was at first set aside as a species distinct from the above because of the more robust carapace, the noticeably shorter first peraeopods, and the slightly longer exopod of the uropod. The appendages are otherwise close to those of the type.

The carapace is more arched dorsally as seen from the side and is relatively wider and deeper, with the sides, as seen from above, more convex. The whole frontal lobe is relatively wider.

In the third maxilliped the basis is a little shorter than in the type and the carpus of the first peraeopod reaches only to level of antero-lateral angle of carapace instead of beyond it, while the basis of this leg is only about half as long again as rest of limb, but has the long inner distal tooth as figured. The basis of the second peraeopod is relatively a little shorter, but the rest of the limb is composed of the unusually short joints as described. The robust distal carpal seta of the posterior legs is a trifle longer.

Uropods are much as in the type, but the exopod is two-thirds as long as endopod, there are three spines on inner edge of peduncle and five on inner margin of first joint of endopod, while the terminal spines of both rami are considerably longer.

The telson (fig. 22, B) has the post-anal portion a little longer, the lateral serrations considerably larger, and the terminal and subterminal spines longer and stouter.

Length 3·8 mm. Type in South Australian Museum, Reg. No. C. 2676.

Ovigerous female. C.—(slender form). In striking contrast to the robust variety, this differs from the type in the extremely elongate carapace, which is three times as long as deep, and twice as long as greatest width. The pseudo-rostrum is long, subtruncate in front, with the lobes meeting for a distance equal to about one-sixth of length of carapace. Antero-lateral angle with three teeth.

The basis of the first peraeopod is shorter than in the type, not quite half as long again as rest of limb; the basis of the second peraeopod, as in form B is likewise relatively shorter than in the type.

The lateral margins of the telson are distinctly serrate, and the terminal and lateral spines slender. In the uropods the armature is as in the type, but as in the much larger robust variety the exopod is two-thirds as long as the three-segmentate endopod; the latter has the longer terminal spine almost as long as the ramus.

Length 2·9 mm.

Adult male. C. Of the specimens here referred to *ambigua*, the only males belong to this small variety.

Carapace one-third of total length of animal and one-third as long again as pedigerous somites together; it is two and three-fourths times as long as deep and is a little wider than deep; seen from above it is only slightly broadened towards the rear, and viewed from the side the dorsal margin is little arched. Antero-lateral margin scarcely concave and antero-lateral angle with three small teeth. Pseudorostral lobes meeting for a distance equal to about one-fifth of length of carapace; the pseudorostrum is somewhat downbent. Ocular lobe not larger (relatively) than in female, slightly constricted at base.

Second and fourth somites markedly longer on back than the others; second well-produced anteriorly on sides, where its lobe generously overlaps first somite; third and fourth somites extended markedly backwards on sides, the second and third peraeopods separated by a wide interspace.

Pleon nearly half as long again as carapace; telson with rather long and slender apical and lateral spines and distinct serrations (fig. 23, tels.)

First antenna with flagellum three-segmentate and as long as last joint of peduncle; accessory lash small, apparently single-jointed. Second antenna with the eleven-segmentate flagellum more than half as long again as the slender peduncle.

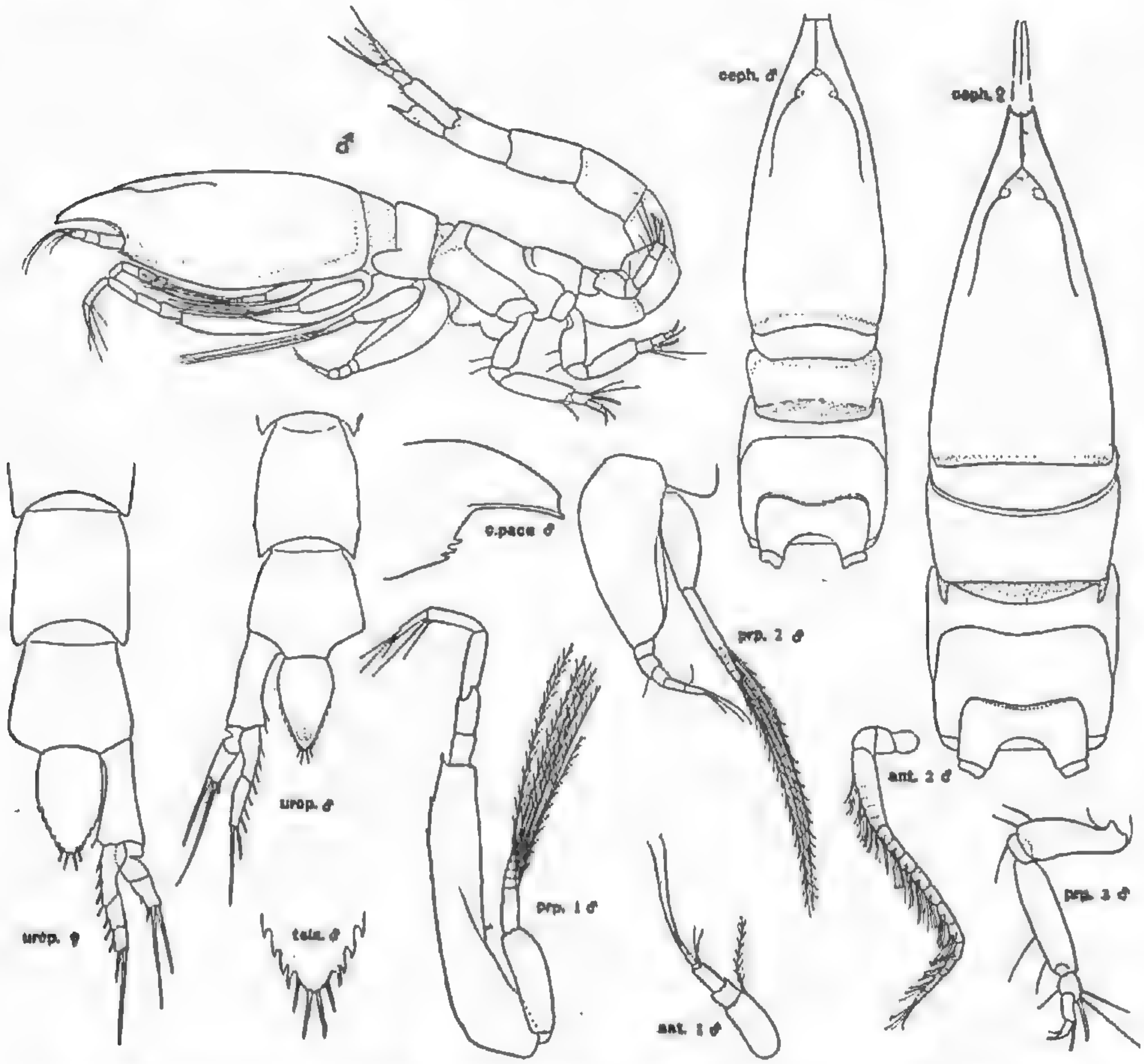

Fig. 23. *Gynodiastylis ambigua*, ovigerous female and adult male of small, slender form – C; lateral view of male and (ceph.) cephalothorax of both sexes from above (× 43); c. pace., front of carapace (× 66); ant., first and second antennae (× 66); prp., first to third peraeopods (× 66); urop., uropod with fifth and sixth pleon somites, and telson (× 66); tels., distal end of telson (× 200).

First peraeopod with carpus barely exceeding the antennal angle; basis only one-third as long again as combined lengths of remaining joints, which are much as described for the type female.

Second peraeopod with exopod longer than basis, which is little more than twice as long as rest of limb; ischium relatively large but shorter than either merus or carpus, which in turn are shorter than either the subequal propodus or dactylus.

Third and fourth peraeopods both without trace of exopods, and in other respects resembling those of female; the propodal seta is short.

Peduncle of uropod very slightly longer than telson and with two slender short spines near distal end of inner margin; endopod as long as peduncle, divided into two joints subequal in length (three-segmentate in all females), each with four spines on inner margin; exopod more than half, but less than two-thirds length of endopod.

Colour white. Length 2·5 mm.

Loc. New South Wales: Ulladulla, Brush Island, 45 fath., in fine silt on flathead grounds (D. Rochford, Jan., 1945). Types in South Australian Museum, Reg. No. C. 2693–2694.

While this species in some respects resembles *laevis* (Calman, 1911, p. 371, pl. xxxv, fig. 32–39) the uropods and armed telson are very distinctive.

As the male is known only in the last of the three forms described and as the females resemble each other in the character of the appendages they are regarded provisionally as variants of one species. The differences between the robust (B) and attenuate (C) varieties, in both size and form, are, as mentioned, very striking.

GYNODIASTYLIS ATTENUATA sp. nov.

Adult male. Carapace completely smooth, almost one-third of total length of animal and as long as pedigerous somites and first pleon somite together; it is very slender, barely wider than deep, more than two and one-half times as long

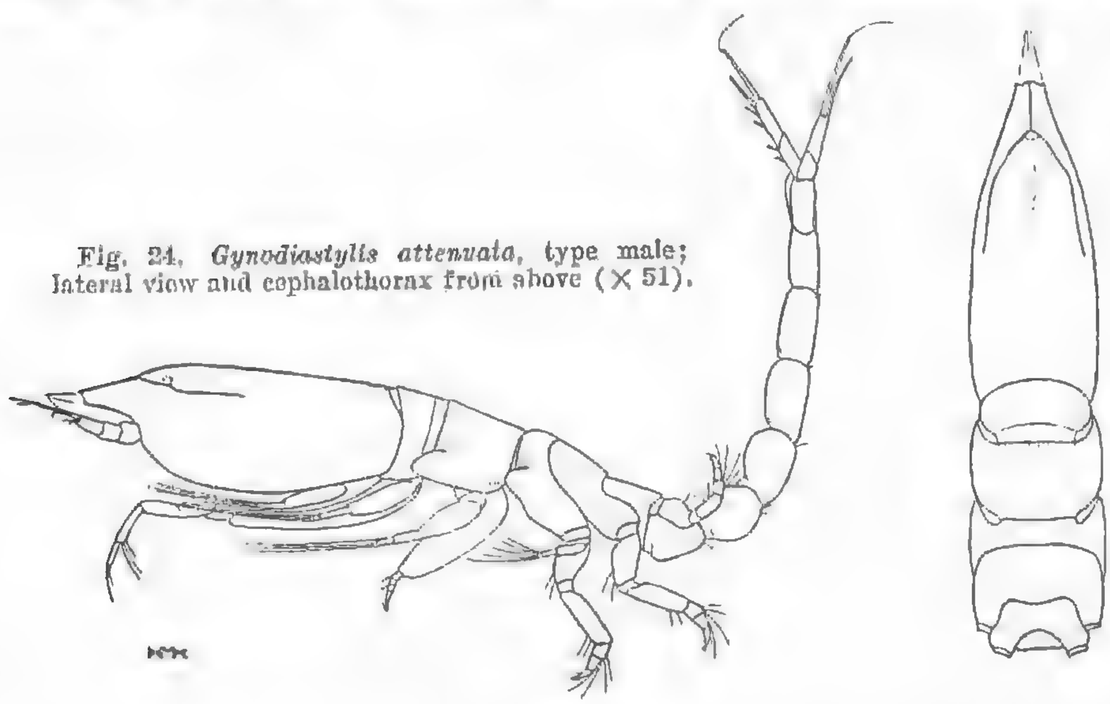

Fig. 24. *Gynodiastylis attenuata*, type male; lateral view and cephalothorax from above (× 51).

as deep, and with dorsal margin from posterior end to ocular lobe, almost straight. Antero-lateral margin scarcely at all excavate and antennal angle rounded, without denticles. Pseudorostrum a little downbent, narrowly subtruncate in front both as seen from above and from the side, the lobes meeting for a distance equal to nearly one-fifth of total length of carapace. Frontal lobe with sutures distinct; eye-lobe subtriangular, longer than wide, with three faintly marked ocular areas.

Second pedigerous somite dorsally longer than any of the others, its anterior pleural lobes overlapping the first, which is relatively quite long; third and fourth somites decidely produced backwards, the second and third peraeopods rather widely separated.

Pleon three-fourths as long as cephalothorax; fifth somite fully one-fourth as long again as sixth, which is slightly widened posteriorly, where it is quite as wide as long; telson plump, subcordate, shorter than sixth somite, with no post-anal portion and with no discernible terminal or lateral spines.

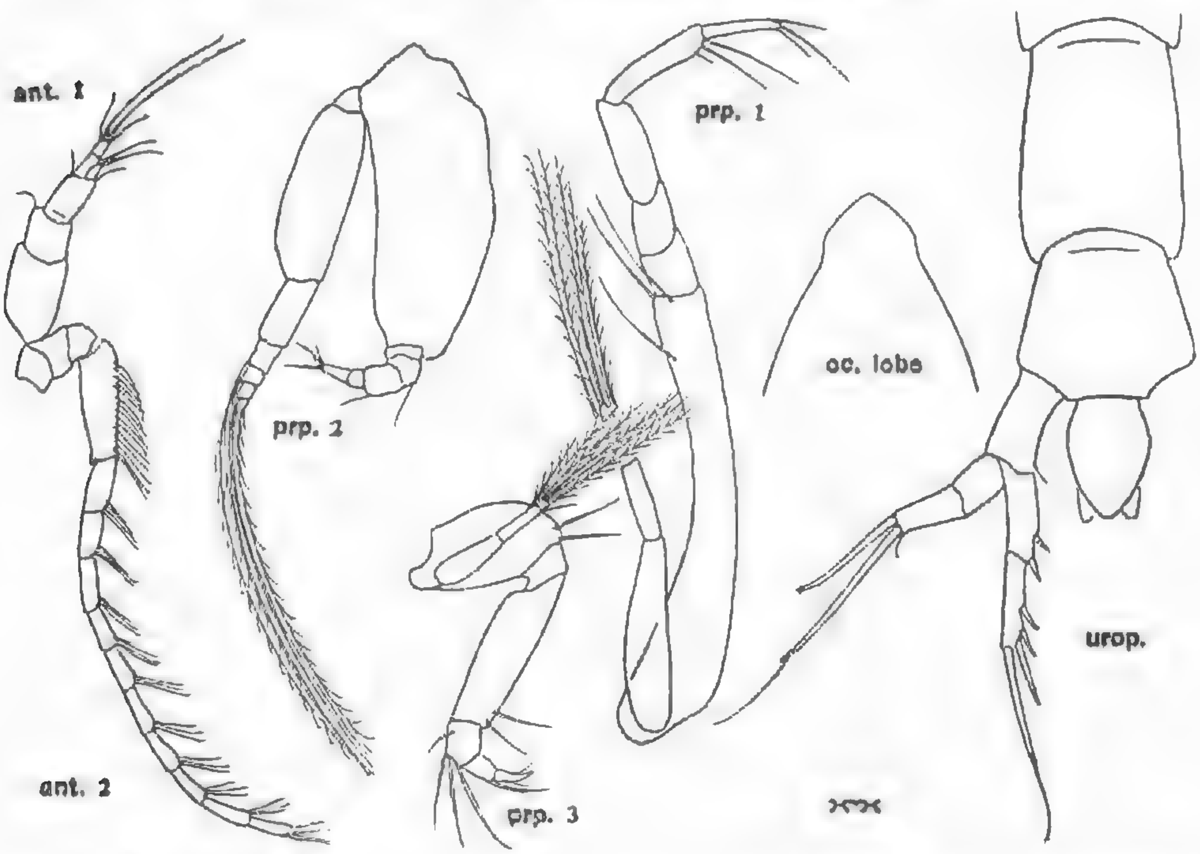

Fig. 25. *Gynodiastylis attenuata*, paratype male; oc. lobe, ocular lobe; ant., first and second antennae; prp., first to third peraeopods; urop., uropod with fifth and sixth pleon somites, and telson (all × 114).

First antenna stout, with first joint of peduncle not much longer than second and third together; third joint little longer than second; flagellum two-jointed, as long as second joint of peduncle, and twice as long as the apparently single-jointed accessory lash. Second antenna shorter than carapace, slender, with relatively short peduncle and ten-jointed flagellum, which is fully twice as long as peduncle.

First peraeopod barely extending beyond level of apex of pseudorostrum when fully extended, the basis little longer than rest of limb; carpus about one-fourth length of basis, subequal in length to propodus, one-fourth as long again as dactylus, and equal in length to ischium and merus combined.

Second peraeopod with exopod fully as long as basis, which is broad and is two and one-half times as long as the abbreviated terminal joints together; ischium distinct, propodus much shorter than dactylus, and merus about as long as propodus and dactylus together.

Third peraeopod with short exopod, furnished with two-jointed flagellum and plumose setae; fourth leg without trace of exopod. These limbs are not much shorter than the second peraeopod; they have the merus more than twice as long as carpus and propodus together and the dactylus stout; the propodal seta and the most distal of the carpal setae reach beyond level of tip of dactylus. Fifth peraeopod about three-fourths as long as fourth.

Peduncle of uropod not quite as long as telson or as exopod, which is three-fifths as long as the endopod; exopod with two stout, subequal spines (composite setae) the longer, not including the slender terminal portion, as long as endopod; first segment of the two-jointed endopod subequal in length to second, and with two inner spines; second joint with three inner spines, successively increasing in length, and with a terminal spine which (excluding its slender setal portion) is two-thirds as long as the ramus.

Length 2·3 mm.

Ovigerous female. The available material of this species was preserved in formalin. A couple of females with marsupium, though completely decalcified, show that in form this sex differs little from the male as figured and has the same attenuated facies. As usual in the genus exopods are well developed on the first and second peraeopods, but are absent on the third maxilliped and third and fourth peraeopods. The second and third peraeopods are more widely separated than in the male.

The endopod of the uropod is two-jointed.

Length 2·5 mm.

Loc. Queensland: Moreton Bay, Myora Bight, surface (I. S. R. Munro, Stations 28, 44, and 55, 50 cm. 40 m. net, 2.30 a.m. and 9.30 p.m. on Nov. 29, 1940, and 9.40 p.m. on Dec. 6, 1940). Types in South Australian Museum, Reg. No. C. 2678 and 2680.

This species in general appearance closely resembles the small variety (C) described under *ambigua*, but may be at once distinguished by the unarmed telson, the difference in the uropods, and the absence of teeth at the antennal angle. It is also very much like the New Zealand *laevis* (Calman, 1911, p. 371, pl. xxxv, fig. 32–39), but that form has the endopod of the uropod unsegmented and only a little longer than the exopod, there is no exopod on the third peraeopod of the male, the joints of the second peraeopod are of different proportions, etc.

GYNODIASTYLIS ECHINATA sp. nov.

Ovigerous female. Integument calcified, opaque, but fragile and easily fractured.

Carapace one-third of total length of animal and two-thirds as long again as pedigerous somites together; it is robust, less than half as long again as deep, its depth not quite equal to greatest width, which is at posterior end; back and sides strongly spinose, the spines more or less distinctly arranged in series, particularly those margining a furrow which curves upwards from antero-lateral angle towards dorsum, longitudinal rows on each side of a dorsal gutter, and along infero-lateral fold; on the back and dorso-laterally there are numerous plumose hairs between the armature. Antero-lateral margin short, deeply excavate; antero-lateral angle armed with a spine (one of a series running back from it). Pseudo-rostrum distally acute as seen from the side, excavate when viewed from above; lobes meeting for a distance equal to fully one-tenth of length of carapace. Sutures fused, so that the whole frontal lobe is not well defined. The ocular lobe is much wider than long, and eyes are not defined, although there is a translucent area on each side of the lobe.

Pedigerous somites spinose, the spines largest on dorsum, where a dorso-lateral, slightly elevated row occur on each side of second to fifth; plumose hairs as on carapace; first and third somites shorter dorsally than the others; pleural parts of second and third produced forwards, those of third to fifth backwards.

Pleon as long as cephalothorax, sparsely spinulose dorso-laterally and ventrally, with spinules on sides (see fig. 26), and with plumose setae on venter; somites stout and rather short, the fifth not much longer than sixth, which is somewhat wider than long; telson longer than any other of the pleon somites, subcylindrical, but with a short, tapering, post-anal portion armed with two small terminal spines (fig. 27, tels.).

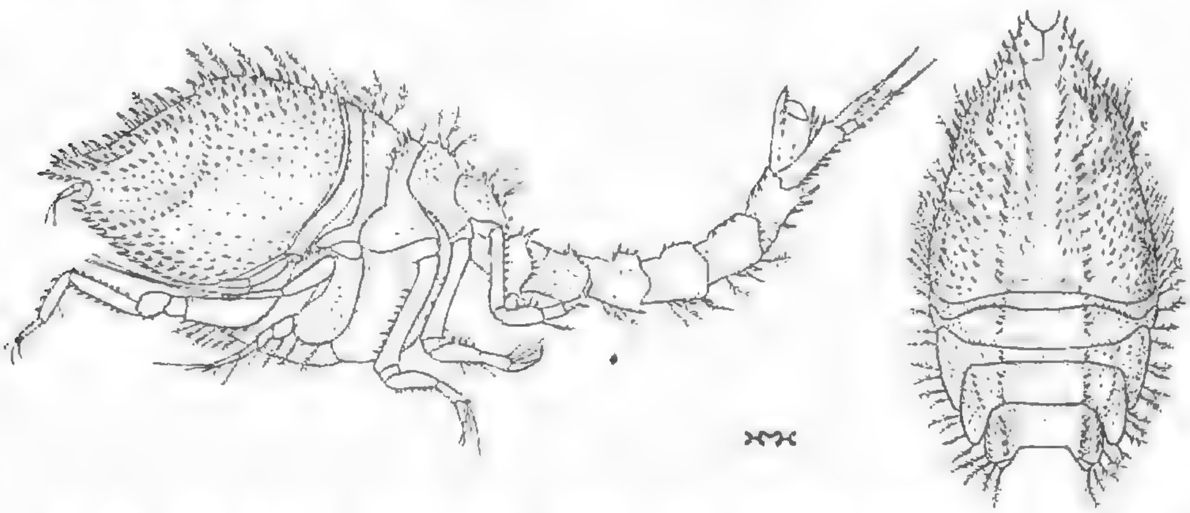

Fig. 26. *Gynodiastylis echinata*, type female; lateral view and cephalothorax from above (× 27).

First and second peduncular joints of the short first antenna armed with spines; first joint stout, nearly as long as rest of peduncle and flagellum together; third joint twice as long as second, and equal in length to the two-jointed main flagellum; accessory flagellum very small.

Second antenna three (?) jointed, spinose.

Mandible with about ten spines.

Third maxilliped with basis to carpus spinulose; basis stout, about as long as remainder of limb and with apex not dilated, but a little forwardly produced at outer distal angle; propodus a little longer than either merus, carpus or dactylus, which are subequal in length.

All peraeopods spiny. First pair short, the carpus barely reaching level of antennal angle; basis wide, about two-thirds as long as rest of limb; carpus twice as long as merus, and only about one-fourth as long again as the long propodus, which bears a single long distal seta; dactylus about half as long as propodus, with a terminal brush of setae, one stouter than the others.

Basis of second peraeopod large, as long as remainder of limb; ischium suppressed; merus, carpus and propodus subequal in length, each only about three-fourths as long as dactylus, the longest terminal seta of which is as long as propodus and dactylus together.

Basis slender in third to fifth peraeopods, as long, or almost as long, as remaining joints together in third and fourth, shorter in fifth; merus not as long as carpus and propodus together and less than half as long as basis in all; apart from length of basis these limbs differ little in size.

Peduncle of uropod stout, spiny, reaching only to posterior ends of anal valves, with strong non-articulate spines on outer face; rami spiny, the exopod as long as peduncle and with longest of the three very unequal terminal spines not quite as long as the ramus; endopod three-jointed, the first joint half as long again

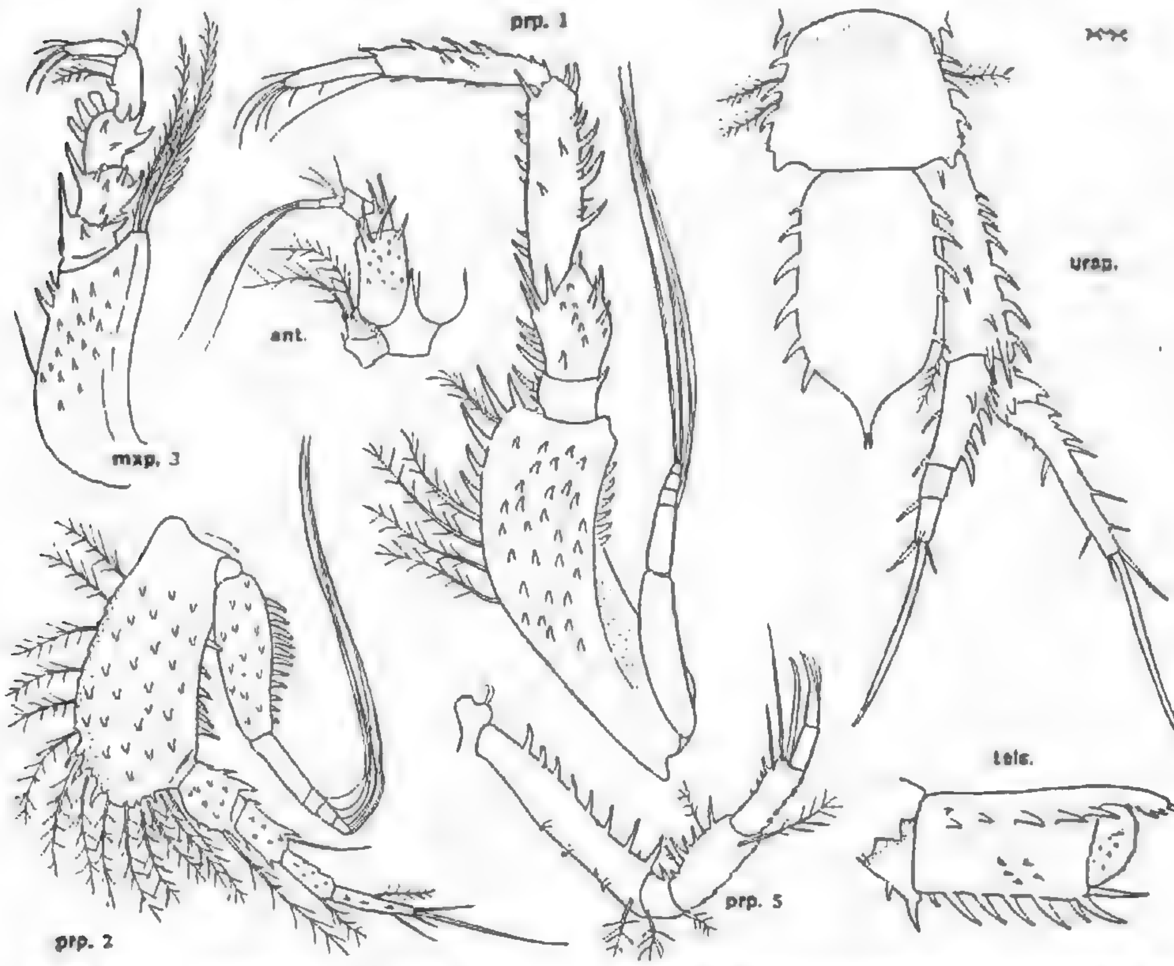

Fig. 27. *Gynodiastylis echinata*, type female; ant., first and second antennae; mxp. and prp., third maxilliped, and first, second and fifth peracopods; urop., uropod with sixth pleon somite and telson; tels., lateral view of telson (all × 70).

as second and third segments together; second joint somewhat shorter than third, the longest terminal spine of which is as long as the whole ramus.

Colour milk-white. Length 3·3 mm.

Loc. New South Wales: 4 miles off Eden, 70 metres, in silt (K. Sheard, Oct., 1943). Type in South Australian Museum, Reg. No. C. 2652.

GYNODIASTYLIS ROSCIDA sp. nov.

Female with developing marsupium. Integument calcified, but not very thick; carapace, excepting along posterior and lower margins, covered with closely set glassy granules.

Carapace large and robust, more than one-third of total length of animal; it is subovate as seen from above, as broad as deep and only one-third as long again as wide; dorsally there is a pair of widely separated longitudinal ridges in posterior half, the back between them sulcate; anteriorly, on and behind frontal lobe, there is another pair placed much closer together, and in front of ocular

lobe these continue to the apex of the pseudorostral lobes; on each side of frontal lobe there is a slight excavation, margined by a faint dorso-lateral curved ridge, conspicuous mainly because of its line of rather pointed granules, which run from the end of each of the aforementioned posterior carinae towards the front of pseudorostrum; each side has a shallow depression, not emphasized by any trace of ridges or folds, and below it the lower part of carapace is rounded, the inferior margin incurved. Antero-lateral margin shallowly concave, and antennal angle rounded, granulate. Pseudorostral lobes pointed in front, meeting for a distance equal to nearly one-fifth of length of carapace. Frontal lobe obscurely defined; ocular lobe wide, with no apparent eyes.

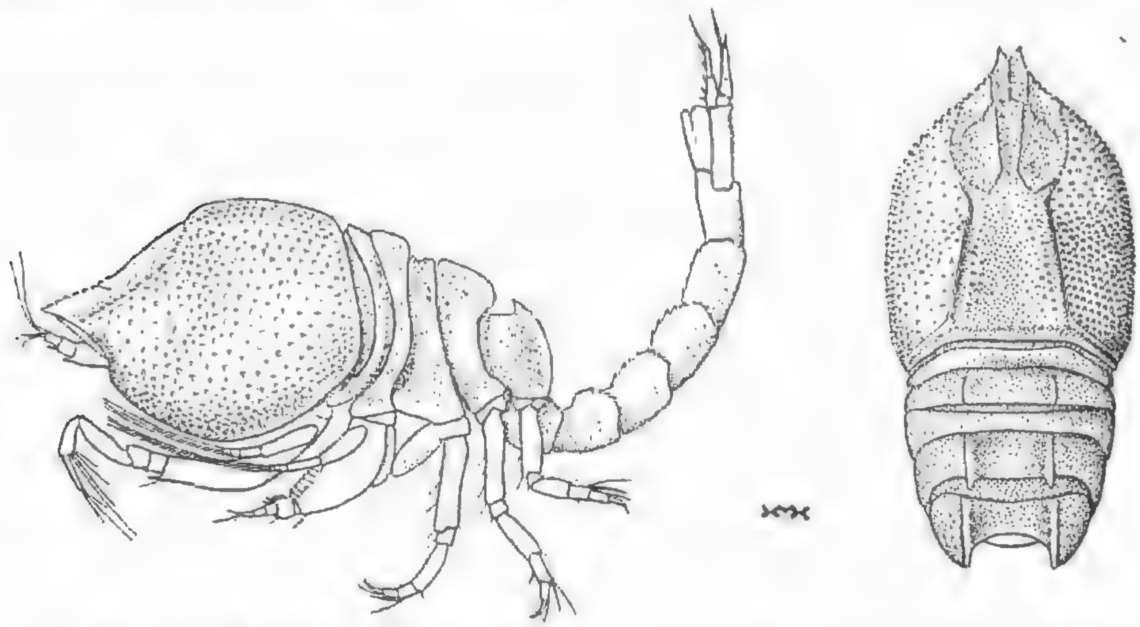

Fig. 28. *Gynodiastylis roscida*, type female; lateral view and cephalothorax from above (× 30).

Pedigerous somites together about two-thirds as long as carapace, the pleural parts of all exposed; second and third not greatly expanded on sides, but pleural portions probably more produced in adult; second, fourth, and fifth somites each with a pair of strong dorso-lateral carinae, those of the last two somites particularly strongly elevated, almost cristiform; there is some sparse granulation.

Pleon twice as long as pedigerous somites together, and thus considerably shorter than cephalothorax; on each side of the first to fifth somites there is a low dorso-lateral, longitudinal serrated crest, directed outward and so most prominent when the animal is viewed from above (fig. 29, urop); sixth somite a little wider than long, not very conspicuously shorter than fifth, and with traces of serrated crests only near anterior end; telson broadly ovate, plump, without any post-anal part, without spines, but with a few serrations on sides near apex, which bears two pairs of insignificant bristles.

First antenna robust; proximal segment of peduncle longer than second and third joints together, with a strong distal tooth; second and third subequal in length, but second much the wider and with two spine-like distal teeth; the short flagellum is two-jointed, the accessory (which is about half as long as the main lash) two-jointed with possibly a small third basal segment. Only three joints can be made out in the second antenna, which is tiny.

Mandibles with ten and eleven spines.

Third maxilliped with basis granulate, a little longer than rest of appendage, with inner margin strongly toothed and a prominent tooth at inner apical angle; external distal angle not much produced, with one of the setae much stouter than the others.

Developing marsupial plates and at least basis of peraeopods studded with granules, which become very small on posterior legs.

First peraeopod short, the carpus reaching little beyond antennal angle, the whole limb not much longer than carapace; with basis equal in length to remaining joints together, in part serrate on both margins and with some conspicuous

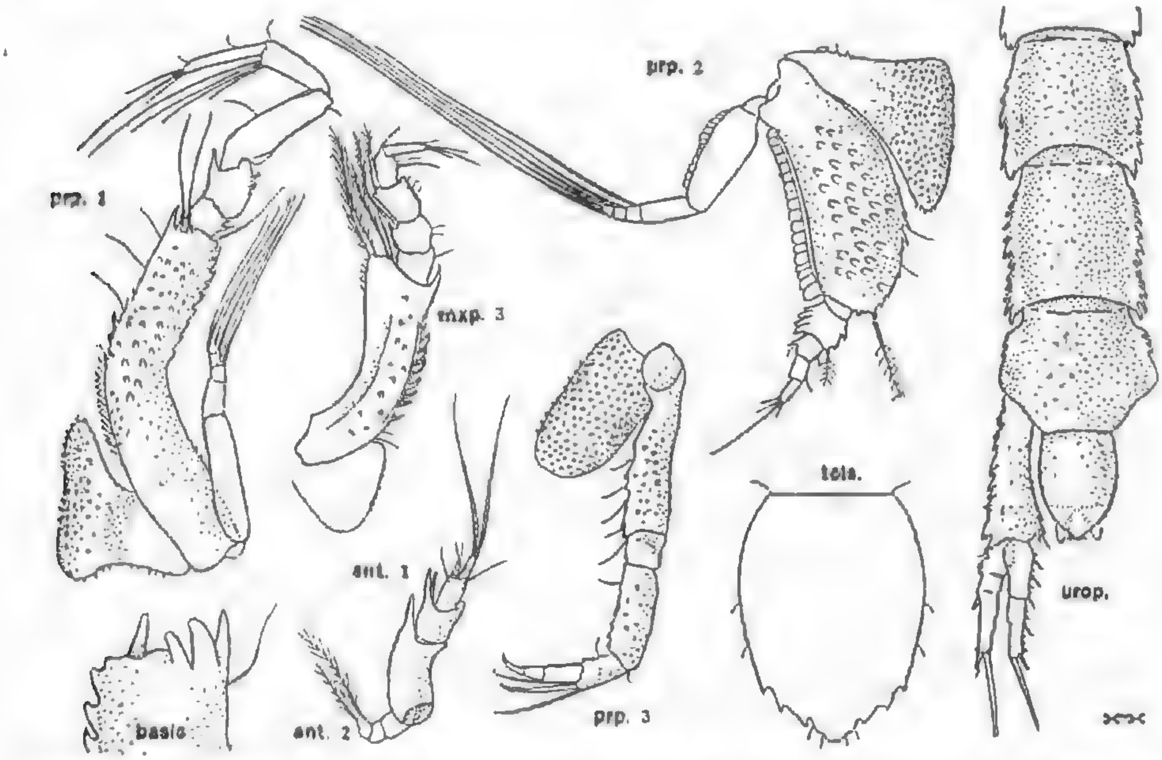

Fig. 29. *Gynodiastylis roscida*, type female; ant., first and second antennae (× 55); mxp., and prp., third maxilliped and first to third peraeopods (× 55); basis, distal end of basis of first peraeopod (× 125); urop., uropod with fourth to sixth pleon somites and telson (× 55); tels., telson (× 125).

teeth at distal end; propodus rather less than two-thirds as long as carpus, as long as ischium and merus combined, and with four unequal distal setae, the longest more than twice as long as the joint; dactylus barely longer than propodus with one of its distal setae very long; ischium and merus spiny.

Second peraeopod only half as long as first, with the wide basis quite twice as long as remaining joints together and with a comb of flattened spines on inner edge; ischium distinct; merus broad, its width emphasized by four flattened crowded teeth on inner margin and a couple of less prominent teeth on outer; carpus a little shorter than merus, subequal in length to propodus and with an inner tooth; dactylus little longer than propodus, with one of the distal setae very long; exopod, including its setae, much longer than the limb.

Third and fourth peraeopods with basis much shorter than rest of limb, and merus distinctly longer than carpus and propodus together; one of the two distal carpal setae much stouter and a little shorter than the other which, like the slender propodal seta, reaches to tip of the rather short, curved, and pointed dactylus. Fifth peraeopod shorter than third or fourth leg, but as long as second.

Peduncle of uropod dilated distally, jaggedly serrate on both margins, but without articulated spines; it is a little longer than the telson and than the subequal rami; endopod divided into two joints of equal length, the first with three inner spines and some spinules, the second with two spines on inner margin, and a terminal spine less than two-thirds the length of the ramus; exopod with a few serrations on outer edge near proximal end and with the longer of the two very unequal terminal spines barely longer than that of endopod.

Colour: carapace and pedigerous somites pale russet brown; pleon and appendages cream. Length 3 mm.

Loc. Tasmania: Marion Bay, 10–17 fath., amongst kelp (W. S. Fairbridge, Euphausiid bottom net, Dec., 1944). Type in South Australian Museum, Reg. No. C. 2744.

Resembles *quadricristata* in some respects, but is readily distinguished by the sculpture.

GYNODIASTYLIS MUTABILIS sp. nov.

Female with brood young. Carapace deep and somewhat compressed, one-third of total length of animal, and less than half as long again as pedigerous somites together; it is only about half as long again as deep, but two-thirds as long again as greatest width; seen from the side the dorsal margin inclines slightly upwards from rear end to above posterior end of frontal lobe, thence descends steeply and obliquely to apex of pseudorostrum; each side of frontal lobe with a depression partly enclosed by a low serrate ridge; each pseudorostral lobe has a dorsal carina running from apex to frontal lobe and then continued for a short distance on the latter; on each side a fine dorso-lateral ridge (with some posterior denticles) curves up from front of pseudorostrum towards the frontal ridge, and a longer transverse carina curves back from antennal angle and then forward to meet the ridge of frontal lobe; in addition to these carinae, which are all very fine, there are a number of short irregular ill-defined longitudinal ridges and some shallow pits on the sides; the median part of the dorsum, from frontal lobe to hinder margin, is depressed, the rather wide sulcus margined by a low longitudinal fold on each side. Antero-lateral margin scarcely excavate; antero-lateral angle obtuse but with a tooth, behind which inferior margin is serrate for a short distance. Pseudorostrum subtruncate and excavate in front, the lobes meeting for a distance equal to about one-seventh of length of carapace. Ocular lobe excessively short, the front margin almost transverse; it is armed with a pair of tiny denticles and is rounded at the lateral corners; no apparent lenses.

First, and particularly third, pedigerous somites dorsally much shorter than any of the others; the third is expanded fore and aft on the sides, and the second and third peraeopods are widely separated; evidently but for the distended brood pouch the anterior pleural lobe of second would overlap the first somite and that of third the posterior part of sides of second; fourth and fifth each with a clear cut dorso-lateral longitudinal carina on each side.

Pleon not quite as long as cephalothorax, the distal somites subcylindrical and rather slender; fifth somite less than one-fourth longer than sixth, which is barely dilated posteriorly where it is not as wide as long; telson equal in length to sixth somite, with nearly one-fifth of length post-anal; sides subparallel almost to level of end of anal valves and with three small lateral teeth, the last pair more prominent than the others; the part distal to the last dentations tapers abruptly to the acute apex, and bears a pair of subapical spines.

First antenna very stout; first segment of peduncle much longer than whole of rest of appendage and, like the short and wide second joint, armed with strong

spine-like projections at distal end; third joint partly concealed by the aforementioned spines; flagellum short, two-segmentate, the accessory lash about half its length and apparently three-jointed. Second antenna three-jointed.

Mandible with about thirteen spines in the row.

Third maxilliped with basis robust, more than half as long as remaining joints together, the distal half of inner margin, like inner edges of ischium, merus and carpus, with closed serrations.

First peraeopod with distal portion missing.

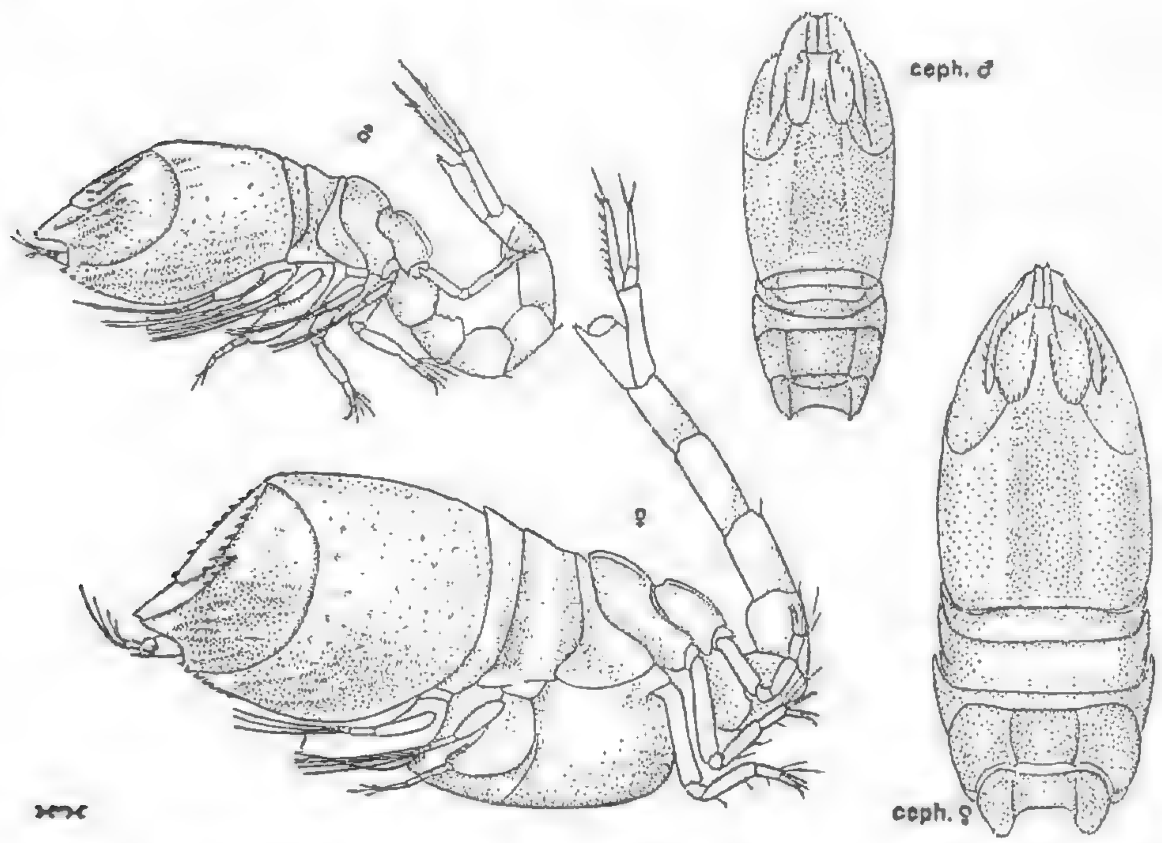

Fig. 30. *Gynodiastylis mutabilis*, types female and male; lateral view and cephalothorax from above (× 30).

Second peraeopod with exopod as long as the wide basis, which is considerably longer than the slender remaining joints together; ischium short but distinct; carpus a little longer than either merus or propodus, the latter barely more than half as long as dactylus.

Third and fourth peraeopods with basis about two-thirds as long as rest of limb, and merus not a great deal longer than combined length of carpus and propodus; carpus with last distal seta stouter and shorter than penultimate and, like stout propodal seta, reaching to about level of apex of the claw-like dactylus. Fifth peraeopod a little shorter than fourth and almost as long as second.

Peduncle of uropod unarmed, barely longer than telson, and equal in length to exopod, which is not quite as long as the single-jointed endopod; the last-named bears seven spines on inner margin and two unequal terminal spines, the longer less than half length of ramus, and subequal in length to the longer of the apical spines of exopod.

Length 3 mm.

Adult male. Resembles the female in general form, but carapace not so deep and dorsal ridges less markedly serrate.

Carapace little deeper than wide and two-thirds as long again as deep; it is one-third of total length of animal and three-fourths as long again as pedigerous somites together. Antero-lateral margin not sloping back as in female and antero-lateral corner dentate. Pseudorostrum, as seen from above, relatively broader than in female, and ocular lobe a little broader but again very short and without eyes.

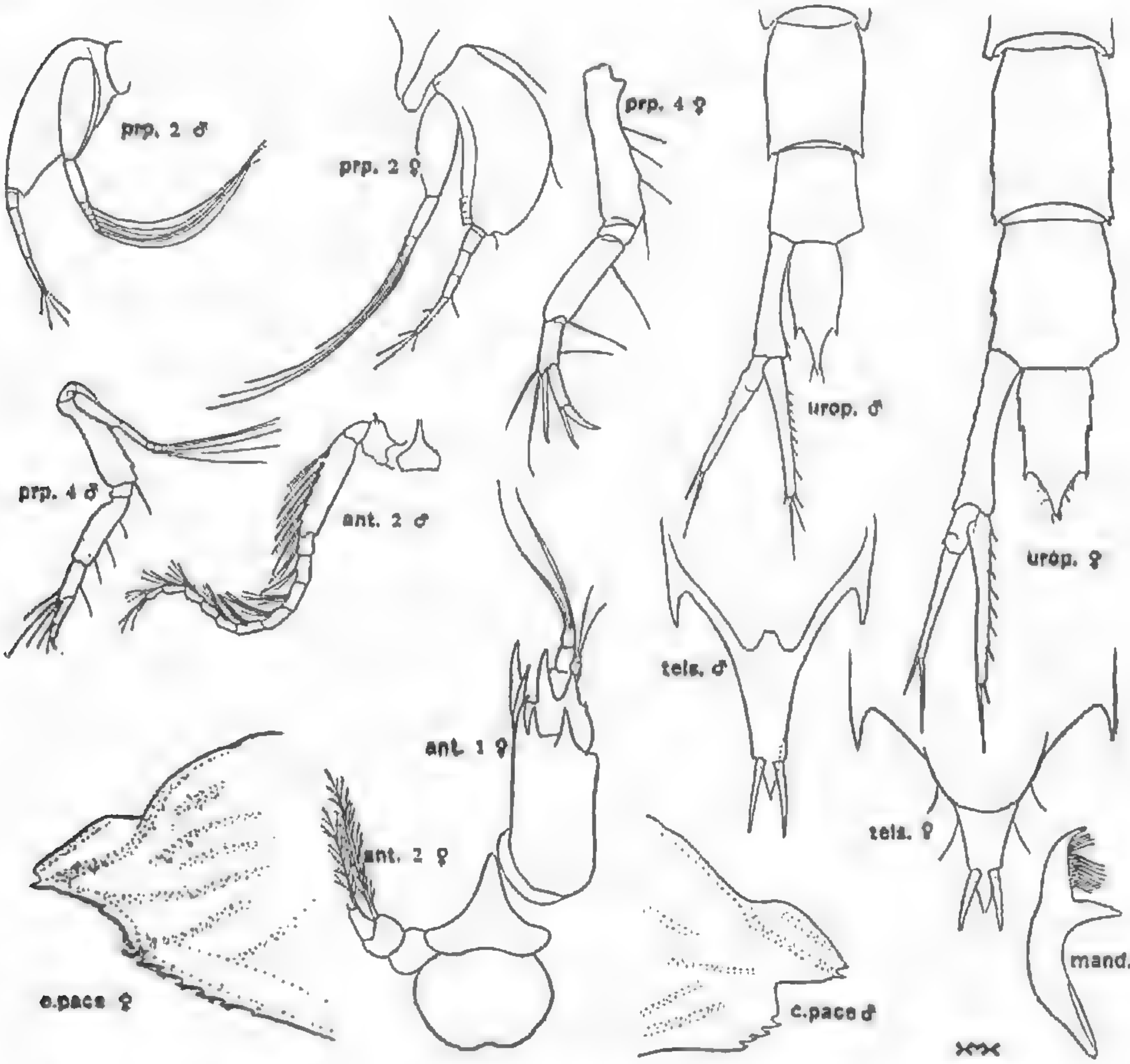

Fig. 31. *Gynodiastylis mutabilis*, types female and male; c. pace, anterior portion of carapace, slightly flattened (× 52); ant., antennae and lips (male, × 52; female, × 135); mand., mandible (× 52); prp., second and fourth peraeopods (× 52); urop., uropod with fifth and sixth pleon somites, and telson (× 52); tels., ventral views of distal portion of telson (× 210).

Anterior pedigerous somites crowded; second with anterior pleural part overlapping first to carapace; third very short dorsally, expanded on sides, but second and third legs not separated more than others.

Pleon not quite as long as cephalothorax and with sides smoother than in female; the telson is narrower and longer (longer than sixth somite), with the distal part quite slender, and there is only one tooth on each lateral margin; the single pair of spines are subterminal and the apex tapers to a point.

Second antenna with the ten-segmentate flagellum not much longer than the peduncle. Upper lip narrower than in female.

Second peraeopod with basis much longer than rest of limb and with dactylus less than twice as long as propodus.

Third and fourth peraeopods both with exopods, which are only about two-thirds as long as those of first and second legs, but which bear long plumose setae; distal carpal seta and propodal seta more slender than in female.

Peduncle of uropod not quite as long as telson and with a short bristle and spine near distal end of inner edge; rami as in female but a couple of extra spines on endopod.

Colour white. Length 2·63 mm.

Loc. New South Wales: Ulladulla, Brush Island, 45 fath., in fine silt on flathead grounds (D. Rochford, Jan., 1945). Types in South Australian Museum, Reg. No. C. 2692 and 2714.

The female described above is quite transparent, the embryos easily visible through the marsupial plates. The male, although small, seems to be mature, for the second antennae bear dense sensory setae and the exopods of the third and fourth legs have the flagellal setae long.

It may be said of the adults of this species that the telson tapers to an acute point without apical spines, the character by which Calman separates his *Oxyurostylis* from *Diastylis* (see Calman, 1912, p. 666 and Zimmer, 1936, p. 437). In *G. mutabilis*, however, the condition results from a prolongation of the apex of the telson over and beyond the bases of what normally would be the terminal spines (see tels. in fig. 32) whereas in *Oxyurostylis* the last of the pairs of spines are truly lateral, which does suggest a suppression of the terminal spines combined with a narrowing of the apex. In the male of *Paradiastylis culicoides* Kemp (1916, p. 398, fig. 5) there is a median, spine-like posterior prolongation of the telson.

In addition to the above specimens, there is before me a young female, with fifth legs as yet quite undeveloped, and which I think belongs without doubt to this species. This example, however, exhibits some interesting differences and is therefore described and figured in some detail.

Juvenile female. Integument calcified, but thin and brittle.

Carapace not quite one-third of total length of animal and twice as long as pedigerous somites together; it is robust, deeper than wide and less than half as long again as deep; dorso-lateral ridge on each side armed with two or three denticles and dorsal longitudinal carina on each pseudorostral lobe faint; frontal lobe with a concavity on each side, the space between with two pairs of teeth; posterior to the frontal lobe is a pair of longitudinal dentate carinae; sides smooth excepting for large pits arranged as shown in figure, one series forming a curved line from posterior end of frontal lobe to antero-lateral portion of carapace; antero-lateral margin widely rounded and strongly dentate, fig. 31, c. pace); a small but distinct antennal notch. Pseudorostral lobes irregularly subtruncate in front, the distal ends of the aforementioned carinae projecting as small points; meeting for a distance equal to about one-sixth length of carapace. Ocular lobe wide and extremely short, armed with a tiny tooth on each side and without apparent lenses.

First three pedigerous somites short and crowded dorsally; second moderately expanded fore and aft, and the third peraeopods not widely separated; second and fourth with a pair of dorsal spines, third somite with two obsolete spines.

First five pleon somites armed with dorso-lateral teeth, and each with a median ridge on underside, flanked at posterior margin by a pair of curved, almost spine-

like setae; infero-lateral corners of these somites armed with a tooth, below which is a smaller tooth; sixth somite almost as long as fifth, dilated at hinder end, where it is distinctly wider than long, and nearly twice as broad as deep; the somite is

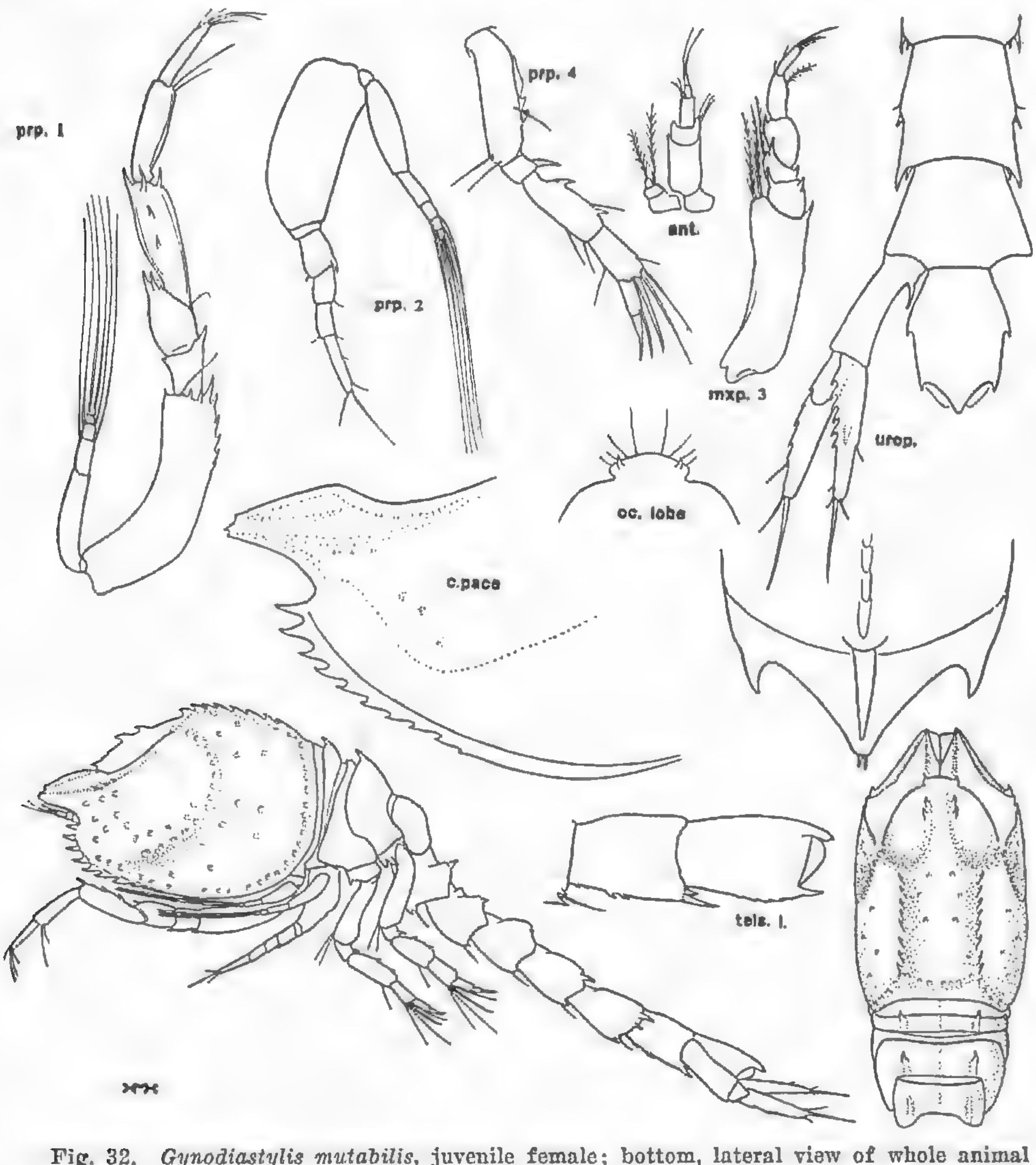

Fig. 32. *Gynodiastylis mutabilis*, juvenile female; bottom, lateral view of whole animal and cephalothorax from above (× 38); oc. lobe and c. pace, ocular lobe and anterior part of carapace (× 72); ant., first and second antennae (× 72); mxp. and prp., third maxilliped, and first, second and fourth peraeopods (× 72); urop., uropod with fifth and sixth pleon somites, and telson (× 72); tels. l., telson and sixth pleon somite from the side (× 72); tels. v., ventral view of distal end of telson (× 250).

dentate-carinate inferiorly, the ridge terminating posteriorly in a strong spine, on each side of which is a similar projection about half the length of the median spine; telson a little longer than any other of the pleon somites, with two tooth-like projections on each side and with a short post-anal part, furnished with two tiny terminal spines; on the underside there is a longitudinal median ridge

projecting posteriorly as a strong spine which reaches almost to level of apex of telson.

First antenna short and robust; first joint of peduncle longer than second and third together. Second antenna three-jointed.

Third maxilliped with basis little longer than rest of limb, with an inner tooth at distal end; ischium, merus and carpus with distal teeth.

First peraeopod rather short, the propodus not reaching much beyond level of apex of pseudorostrum; basis distally dentate, little more than half as long as rest of limb; ischium with a spine at inner distal angle; merus armed with outer distal spines, and carpus dentate at distal end and laterally; propodus three-fourths as long as merus, with only two not very long distal setae; dactylus more than two-thirds length of propodus, with terminal setae shorter than the joint.

Second peraeopod with exopod as long as basis, which is barely shorter than rest of limb; ischium distinct; merus armed with distal teeth, slightly longer than either carpus or propodus, which are subequal in length; dactylus three-fourths as long again as propodus, with slender distal setae, one of which is fully as long as the joint.

Third and fourth peraeopods about equal in size; coxa, basis, ischium and merus with teeth, one on outer face of ischium and two on merus being prominent; merus equal in length to carpus and propodus together or barely longer; fifth legs absent.

Peduncle of uropod subequal in length to fifth pleon somite (longer than telson) with an inner tooth near proximal end; rami subequal in length, the endopod single-jointed and not longer than exopod, which is one-third as long again as peduncle; in both rami the outer margin is serrate and the endopod bears a tooth on outer face; the articulated marginal spines are feeble, and the slender terminal spines are much shorter than the rami.

Colour white. Length 2·4 mm.

Loc. New South Wales: 11 miles off Eden, 120 metres (K. Sheard, A. Trawl, Jan., 1943).

GYNODIASTYLIS ORNATA sp. nov.

Female with developing marsupium. Integument thin, but calcified and brittle, with a few scattered granules.

Carapace more than one-third of total length and nearly twice as long as pedigerous somites together; its greatest depth about two-thirds of length which is almost twice the width; seen from above it is (apart from pseudorostrum) subrectagular in shape, with the antero-lateral margins rounded; on each side a serrate dorso-lateral ridge curves forward from about middle of length; behind these ridges the dorsum is concave almost to hinder margin of carapace, the depression defined by a low ridge on each side; from near posterior limits of dorso-lateral ridges a low and rather broken ridge curves downwards and forwards on each side to the neighbourhood of antero-lateral angle of carapace and marks the hinder and lower limits of a depression; posterior half of sides with large reticulations, the longitudinal edges running together to form incipient ridges. Antero-lateral margin short, shallowly concave; antero-lateral angle subacute and margin behind it serrate for a short distance. Pseudorostrum subacute in front, meeting in front of ocular lobe for a distance equal to fully one-fifth of length of carapace. Frontal lobe sutures fused; ocular lobe rounded, wider than long, with a pair of spinules and three obscure corneal lenses.

Pedigerous somites each with a pair of low dorso-lateral ridges and with a few short plumose setae; first somite almost as long as second; the latter is longer

dorsally than third, the pleural parts of which are well expanded fore and aft, overlapping the second and hinder edge of first in front; second and third legs not widely separated.

Pleon a little shorter than cephalothorax; second to fourth and sixth somites each subequal in length to the telson; fifth but little longer, and sixth not wider than long; telson plump, suboval in shape, without post-anal portion and with apical spines minute.

First joint of peduncle of first antenna longer than second and third joints plus flagellum; first and second with a distal spine, second and third subequal in length; flagella two-jointed, the accessory as long as first joint of main lash.

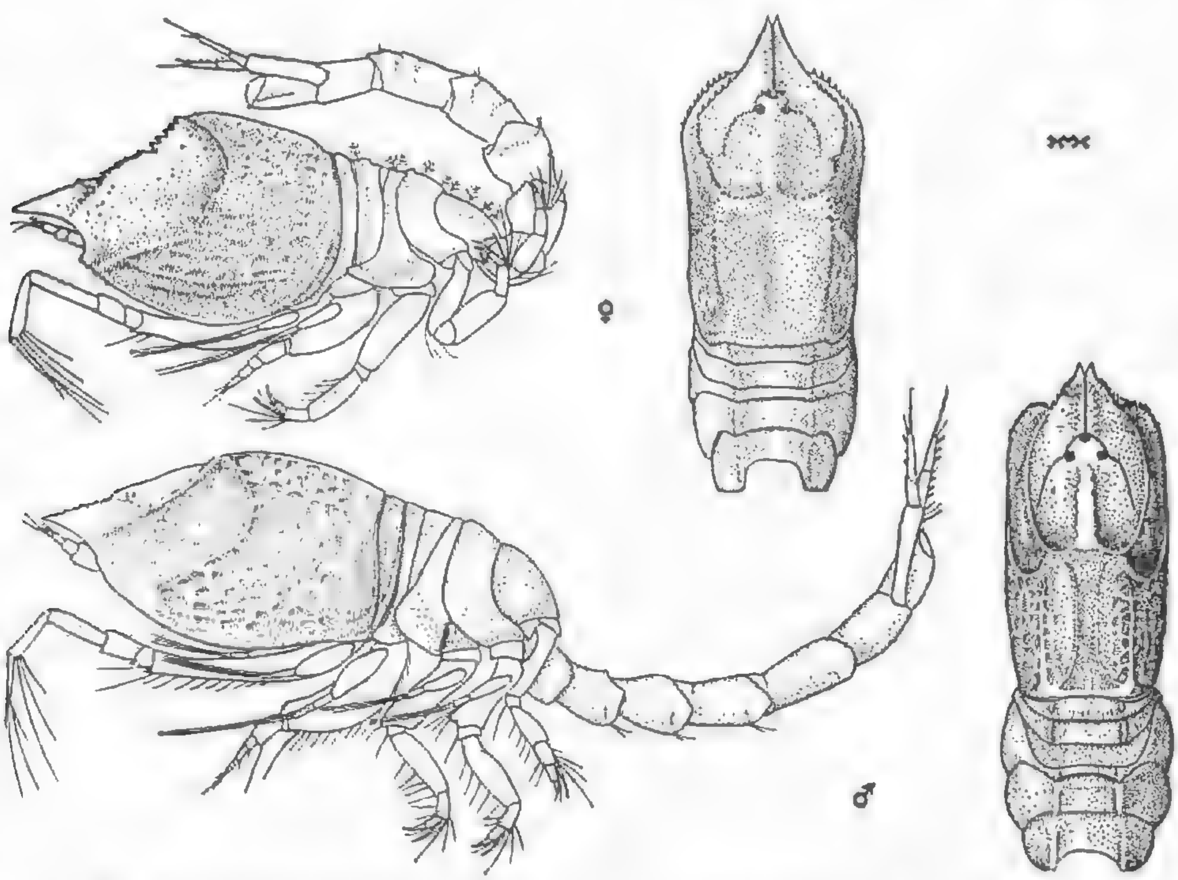

Fig. 33. *Gynodiastylis ornata*, types female and male; lateral views and cephalothorax from above (× 25).

Basis of third maxilliped elongate, half as long again as rest of limb and with a long row of stout plumose setae on inner margin and inner distal angle acute; remaining joints all subequal in length; ischium and merus each with an inner tooth, merus with two projections on inner margin and a small tooth on outer.

First peraeopod with carpus not quite attaining level of apex of pseudo-rostrum; basis almost as long as rest of limb, serrate on inner, outer and distal edges and with a row of plumose inner setae; ischium and merus dentate; propodus five-sixths as long as carpus, and as ischium and merus together, with three inner subdistal setae, the longest of which is twice as long as the joint; dactylus five-sixths as long as propodus, its terminal setae long.

Second peraeopod with the wide basis longer than rest of limb and with margins more or less serrate, and with plumose setae as shown, one seta long; merus wide, together with the short but distinct ischium as long as carpus, propodus and dactylus together, with dentate margins and with a long distal plumose seta; carpus a little shorter than propodus which is almost as long as dactylus.

Third to fifth peraeopods stout; merus of third and fourth about three-fourths as long as carpus and propodus together, in fifth leg equal in length to these joints combined; carpus with a stout inner distal seta reaching level of tip of dactylus, preceded by three more slender setae, the longest of which extends well beyond apex of dactylus.

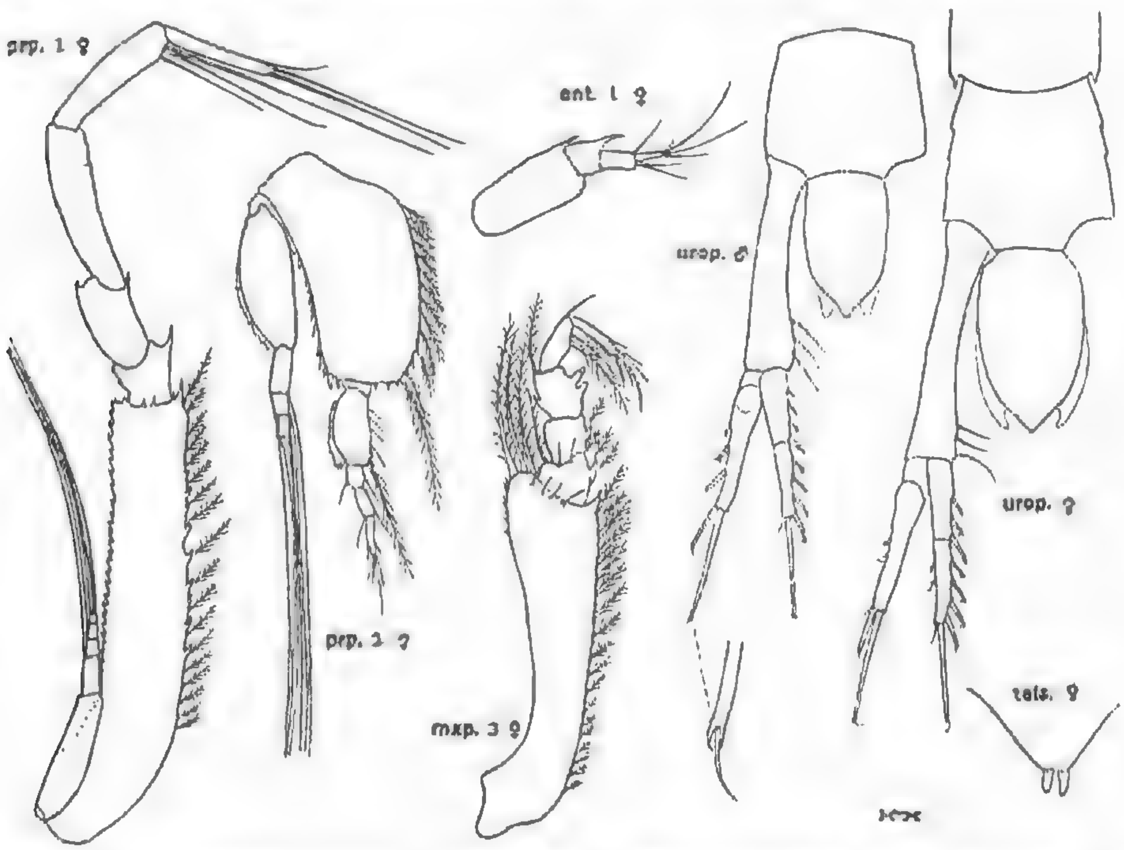

Fig. 34. *Gynodiastylis ornata,* type male and paratype female; ant., mxp. and prp., first antenna, third maxilliped, and first and second peraeopods (× 50); urop., uropod with fifth and sixth pleon somites, and telson (× 50; spine and distal end of telson, × 250).

Uropod with peduncle one-third as long again as telson and with three inner setae near distal end; rami subequal in length, each more than two-thirds the length of peduncle; endopod composed of two joints of equal length, and with three and four inner spines; terminal spine more than half as long as ramus, flanked on outer side by a bristle; exopod with two or three short spines on outer margin and with two terminal spines, one less than half as long as the other, which is more than two-thirds as long as the ramus.

Colour white. Length 3·8 mm.

Adult male. The differences in the shape of the carapace and in the pedigerous somites are shown in the figures. Although the sculpture is on the whole more clearly defined, the dorso-lateral ridge is not serrate (feebly crenulate); the depression in posterior half of back has a central median trough margined by a carina on each side, while the low longitudinal elevation on and behind frontal

lobe is well marked and has the edges rugose, almost tuberculate. The frontal lobe suture is distinct, as are also the corneal lenses. The antero-lateral margin is less concave and the antero-lateral "angle" rounded and serrate.

Peduncle of uropod half as long again as telson; rami as in female, save for an extra inner spine on first joint of endopod.

Length 4 mm.

Loc. Tasmania: off Babel Island, 0–50 metres (type male, "Warreen" Station 29, Jan., 1939). New South Wales: 5 miles off Eden, 60 metres, on mud (type female, K. Sheard, submarine light, Dec., 1943); Ulladulla, Brush Island, 45 fath., in fine silt on flathead grounds (D. Rochford, Jan., 1945). Types in South Australian Museum, Reg. No. C. 2337 and 2688.

The type male, which is illustrated, has clear-cut large reticulations on the hinder part of the sides, but in another male (Brush Island) the edges run together to form irregular ridges as noted for the female. Evidently the somewhat irregular carinae consistently found in this situation in such species as *costata, turgida* and *lata* are so derived.

GYNODIASTYLIS STRUMOSA sp. nov.

Ovigerous female. Integument moderately calcified and brittle; the surface, apart from the major tumidities, is slightly irregular and finely granulate; with scattered pellucid spots on thorax and most of pleon, while in certain lighting there is an effect of short irregular raised lines on carapace.

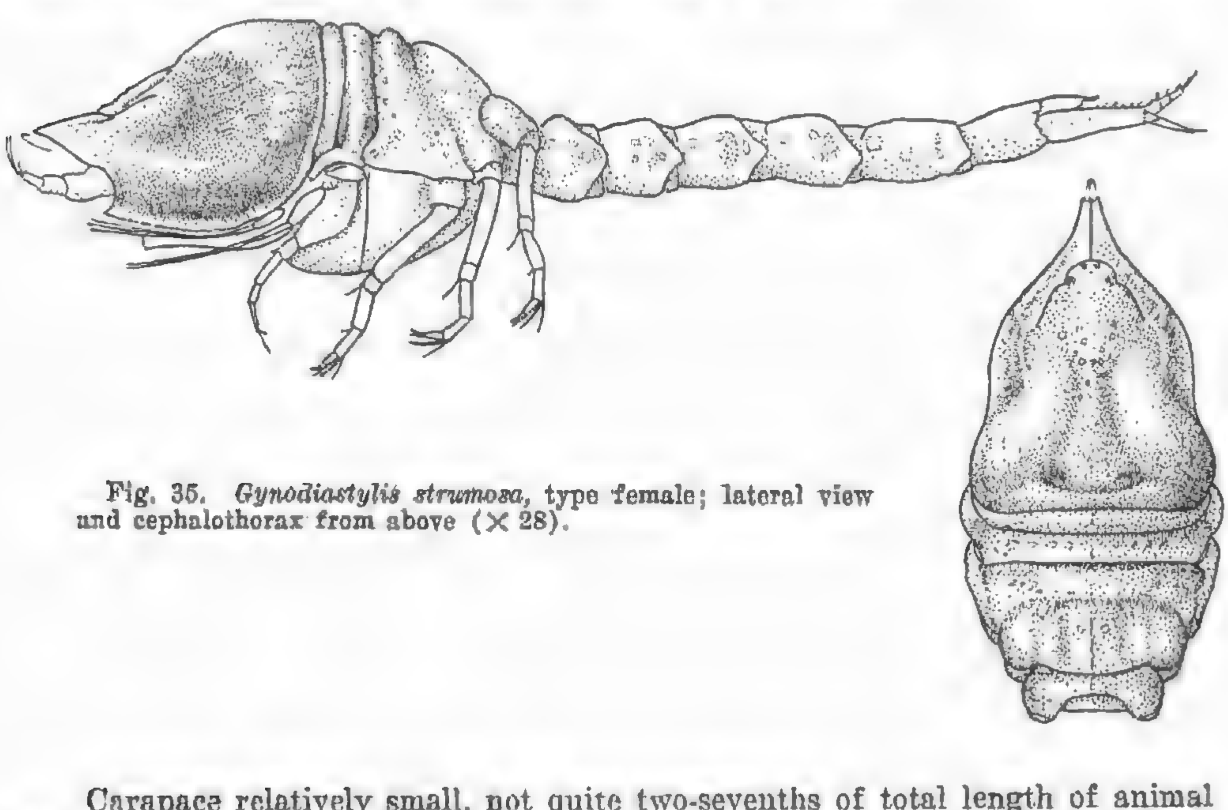

Fig. 35. *Gynodiastylis strumosa,* type female; lateral view and cephalothorax from above (× 28).

Carapace relatively small, not quite two-sevenths of total length of animal and as long as pedigerous somites and first pleon somite together; it is half as long again as deep, somewhat depressed and widest across branchial regions, which are considerably inflated; there is a tumidity on each side below the frontal lobe, the surface of which is rounded and slightly elevated; below the dorso-lateral tumidity the side is concave, and inferior to the depression is an elongate swelling, traversed by a low longitudinal ridge, not very well defined; the rear of the

depression is bounded by the kidney-shaped branchial swellings which, viewed from above, are elevated above the median portion of the dorsum, which is convex, with a pair of pits near the swollen posterior edge. Antero-lateral margin rather deeply concave; antennal angle acute and margin posterior to it finely serrate. Pseudorostrum narrowly truncate in front, and very oblique as seen from the

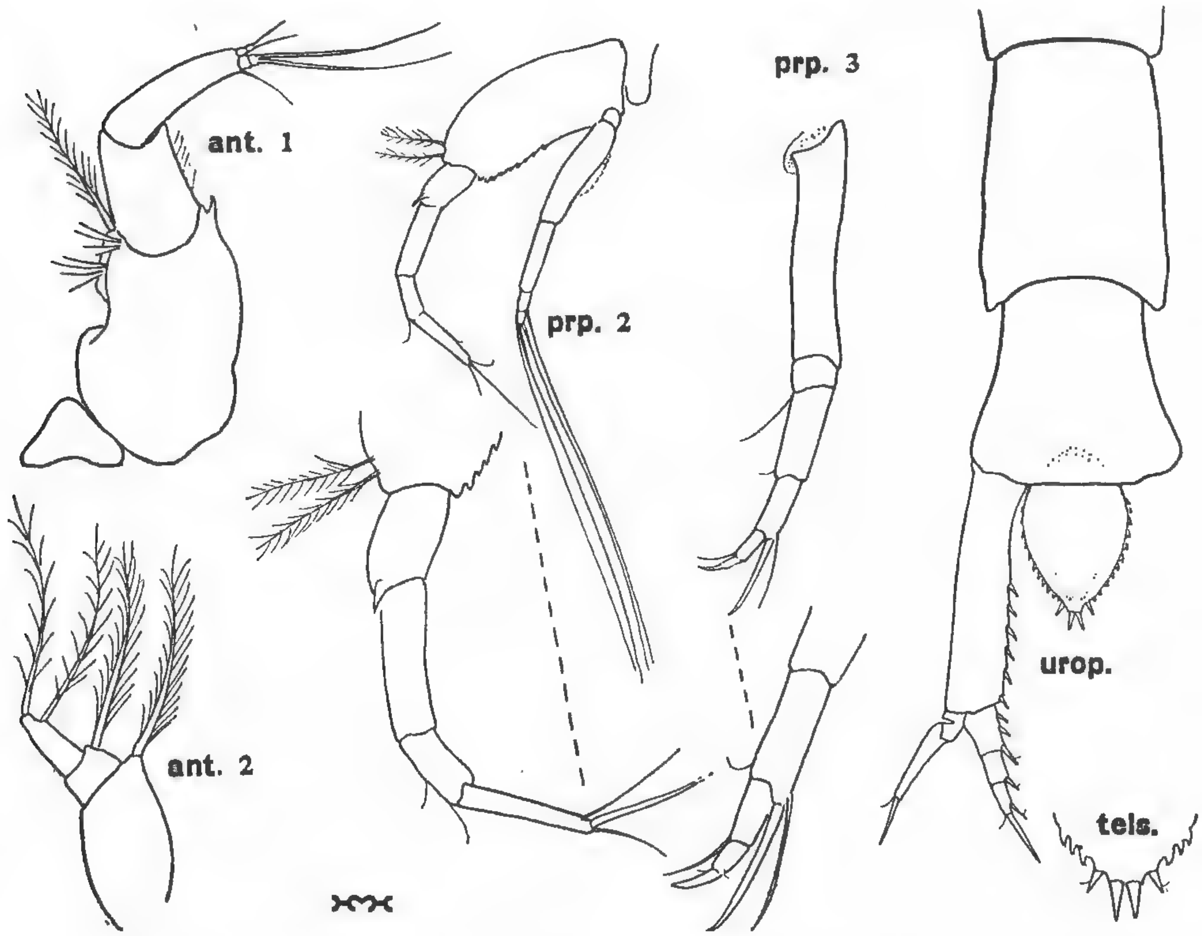

Fig. 36. *Gynodiastylis strumosa*, type female; ant., first antenna with upper lip, and second antenna (× 110); prp., second and third peraeopods (× 58; distal joints, × 110); urop., uropod with fifth and sixth pleon somites, and telson (× 58); tels., distal end of telson (× 110).

side; lobes meeting for a distance equal to one-fifth of length of carapace. Frontal lobe well defined; ocular lobe rounded, twice as wide as long and with indistinct corneal areas.

First to third pedigerous somites successively increasing a little in length dorsally; pleural parts of second produced forwards across first somite, those of third moderately expanded anteriorly, and markedly so to the rear; fourth somite abruptly longer on the back, completely ankylosed with third, and with a dorso-lateral very swollen carina on each side.

Pleon cylindrical, not depressed; longer than cephalothorax; fifth somite one-third as long again as sixth, which is slightly dilated posteriorly, where it is as broad as long; telson cordate, plump, with lateral edges finely serrate; there is a very short post-anal part, armed with a pair of short stout terminal spines, flanked on each side by a similar spine.

First antenna relatively large and robust; first joint of peduncle with width equal to two-thirds its length, which is equal to that of the other two; second

joint little shorter than third; flagella each two-jointed and subequal in length, the main lash unusually short.

Second antenna as long as first joint of antennule; three-jointed, the terminal segment more than twice as long as second and apparently composed of two fused joints, a small terminal part being separated by a constriction but no suture.

Distal joints of third maxilliped and first peraeopod missing.

Second peraeopod shorter than third; basis almost as long as rest of limb; ischium completely suppressed; merus with a tooth at distal end; carpus half as long again as merus, nearly twice as long as propodus and barely longer than dactylus.

Third and fourth peraeopods with basis as long, and nearly as long, as rest of limb; merus as long as carpus and propodus together; two distal carpal setae, subequal in length but one much stouter than the other, reaching just beyond tip of the stout dactylus. Fifth peraeopod not much shorter than fourth.

Uropod with peduncle twice as long as telson and more than twice as long as the subequal rami; its inner margin bears half a dozen short robust spines in distal half; endopod three-jointed, the joints with three, one and one inner spines respectively; first segment longer than either second or third, which are subequal in length; terminal spine in both exopod and endopod half as long as the ramus.

Colour white. Length 4·1 mm.

Loc. Tasmania: off Babel Island, 39° 55′ S., 148° 31′ E., 0–50 metres ("Warreen" Station 29, Jan., 1939). Type in South Australian Museum, Reg. No. C. 2726.

The species offers some unusual features for the genus, notably the robust antennae. It agrees with *margarita* in having the peduncle of the uropod twice as long as the telson and at the same time twice the length of the endopod, but is in some other respects very different.

GYNODIASTYLIS MARGARITA sp. nov.

Ovigerous female. Integument not polished, but of pearly lustre, with fine but distinct reticulate pattern; indurated but rather fragile.

Carapace two-sevenths of total length of animal; three-fourths as deep as greatest breadth, which occurs across the branchial regions, and three-fourths as long again as deep; no well-defined sculpture, but there is a slight dorso-lateral tumidity on each side anteriorly, and a low boss at each postero-lateral corner of frontal lobe, while the branchial regions are somewhat inflated, rounded, with a slight hollow between them on the back, at the hinder end of which is a pair of pits. Antero-lateral margin almost straight, slightly notched above the finely dentate, obtuse, antero-lateral angle; inferior margin behind this with small serrations. Pseudorostrum subacute both as seen from above and from the side, the lobes meeting for a distance equal to more than one-fifth of total length of carapace; respiratory siphons rather long. Frontal lobe wide, distinctly marked off; ocular lobe very short and broad, with eyes visible as three opaque pale areas.

Pedigerous somites together well over half as long as carapace, successively increasing in dorsal length to fourth; pleural parts of second overlapping those of first in front; third somite only moderately expanded fore and aft on the sides, but second and third legs separated by a space decidedly greater than that between the other legs.

Pleon distinctly longer than cephalothorax and, like pedigerous somites, with pellucid spots; somites successively increasing a little in length, the fifth almost half as long again as sixth, which is not cylindrical like the others but is widened

posteriorly, where it is fully as broad as long; telson three-fourths as long as sixth somite, cordate, tapering in distal third to the narrowly rounded apex, which bears a pair of short spines, flanked on each side by a bristle; quite one-fourth of the dorsal plate is post-anal.

First antenna long, with basal joint of peduncle distinctly shorter than second and third combined; third about one-third as long again as second; both flagella two-jointed, the main lash only one-fourth as long as the last peduncular segment, the accessory not as long as the first joint of the other. Second antenna as long as first joint of peduncle of first antenna; it is four-jointed, the last segment tiny,

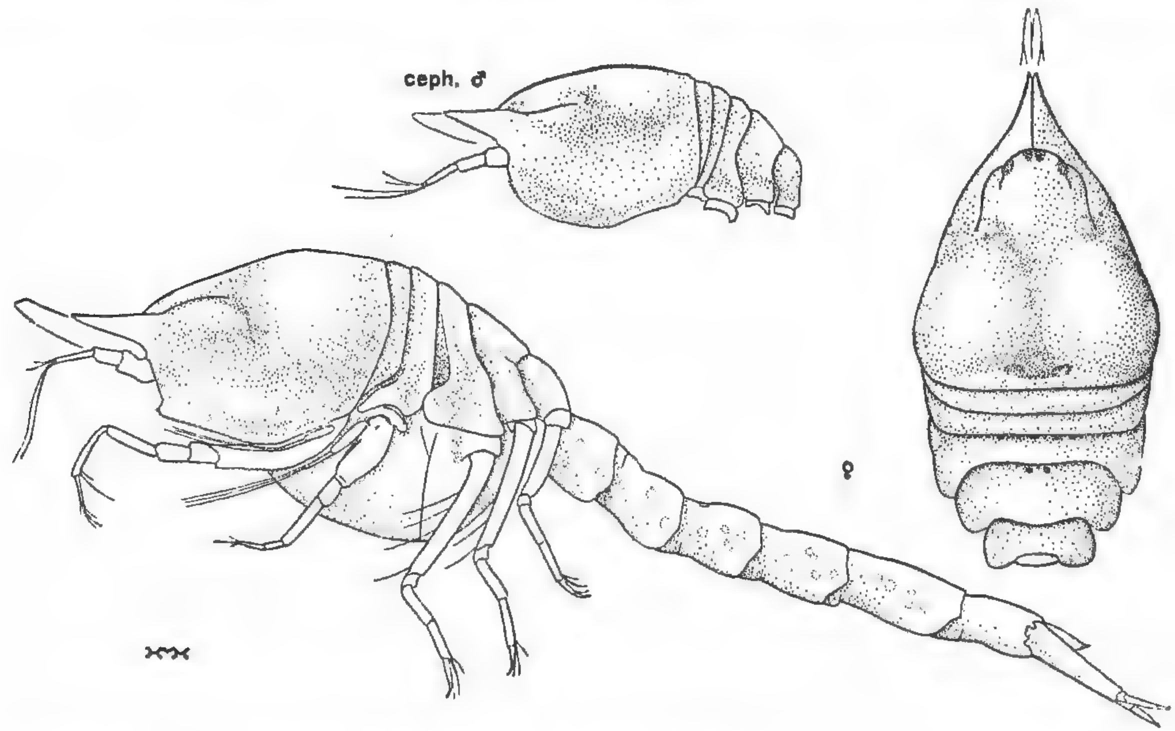

Fig. 37. *Gynodiastylis margarita*, type female; lateral view and cephalothorax from above. ceph., Cephalothorax of allotype subadult male from the side (all × 21).

the third much longer than second and the first (which has a distal tooth) as long as second and third together (in the figures the two antennae are not shown to the same scale).

Mandible with nine or ten spines in the row.

Third maxilliped short and stout; basis a little shorter than rest of limb, distally dilated and a little forwardly produced externally, where the usual setae are stout and long; ischium, merus, and carpus wide; carpus, propodus, and dactylus subequal in length, each longer than either ischium or merus.

First peraeopod, when extended, reaching little beyond apex of pseudo-rostrum, its merus not quite attaining to level of antennal angle; basis about two-thirds as long as rest of limb, serrate on inner edge; propodus subequal in length to carpus, with a long and a short inner seta at distal end; dactylus barely more than half as long as propodus, with one of the terminal setae stout and as long as the joint; exopod slender.

Second peraeopod about two-thirds as long as first; basis stout, shorter than the slender exopod and less than two-thirds as long as remainder of limb; ischium suppressed; merus with a small distal tooth; carpus fully two and one-half times

as long as propodus, which is a little shorter than merus and is two-thirds as long as dactylus.

Fossorial peraeopods slender, the basis of fifth pair much shorter than that of the third and fourth pairs, in which it is fully as long as the remaining joints together; merus and carpus subequal in length, propodus only about half as long as either; one of the two carpal setae is stout, longer than the other and, like the slender propodal seta, reaches the level of tip of the short and slender dactylus.

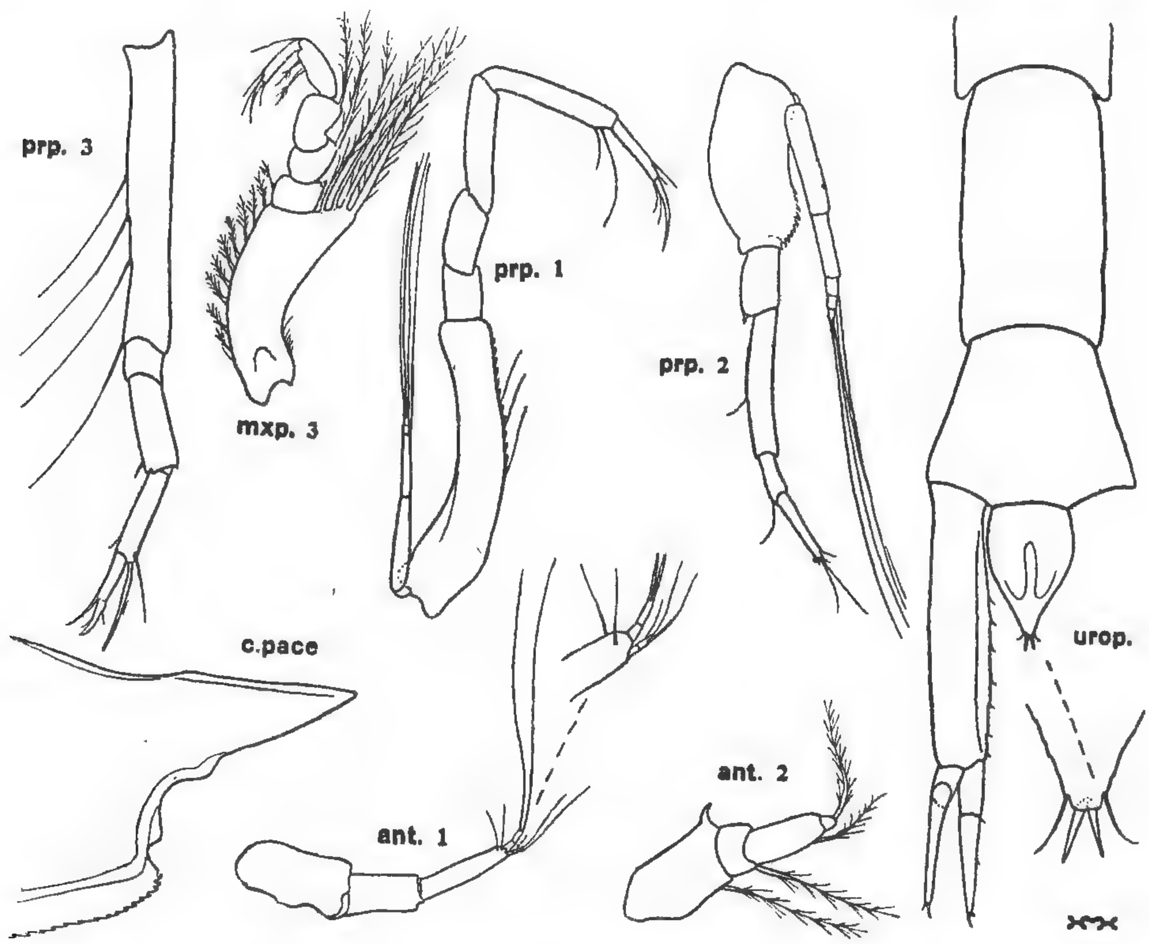

Fig. 38. *Gynodiastylis margarita*, paratype ovigerous female; c. pace, anterior portion of carapace (× 50); ant. 1, first antenna (× 50; flagella, × 115); ant. 2, second antenna (× 115); mxp. and prp., third maxilliped and first to third peraeopods (× 50); urop., uropod with fifth and sixth pleon somites, and telson (× 50; distal end of telson, × 150).

In combination with the other characters the uropods are distinctive; the peduncle is wide, not dilated distally, is almost as long as the sixth somite and telson together, and is twice as long as the subequal rami, both of which have insignificant terminal spines; armament is nowhere pronounced, there being seven or eight spaced spinules on inner margin of peduncle and three on that of endopod, which is two-jointed, the distal segment two-thirds as long again as the proximal one.

Length 5·3 mm.

Juvenile male. Lower edge of carapace bent down instead of outwards as in the female and antero-lateral angle more widely rounded; ocular lobe a little wider, but still exceedingly short. The uropods and other appendages are substantially as in the female; exopods are present on the first four pairs of peraeo-

pods. The uropod has the peduncle not quite as long as telson and sixth pleon somite together (probably longer than these in adult male) but fully twice as long as the rami; the proximal segment of the endopod does not differ in length from the distal so markedly.

Length 2·65 mm.

Loc. New South Wales: off Cape Three Points, 41–50 fath., bottom sticky mud and shell ("Thetis" Station 13, Feb., 1898); 5 miles off Eden, 60 metres, on mud (K. Sheard, submarine light, Dec., 1943); 4 miles off Port Hacking, 80 metres, on mud (type loc., K. Sheard, A. Trawl Station 13, May, 1944). Types in South Australian Museum, Reg. No. C. 2689–2690.

The species attains a length of over 6 mm.

GYNODIASTYLIS QUADRICRISTATA sp. nov.

Subadult female. Integument calcified, but thin and fragile.

Carapace large, two-fifths of total length of animal; it is subovate as seen from above, robust, less than half as long again as deep, and almost as wide as deep; on the back a pair of longitudinal carinae, arising at base of ocular lobe, are flanked on each side by a short dorso-lateral ridge, which commences near the hinder corner of frontal lobe; these four carinae reach to about middle of length of carapace, where they are connected by short transverse carinae; from

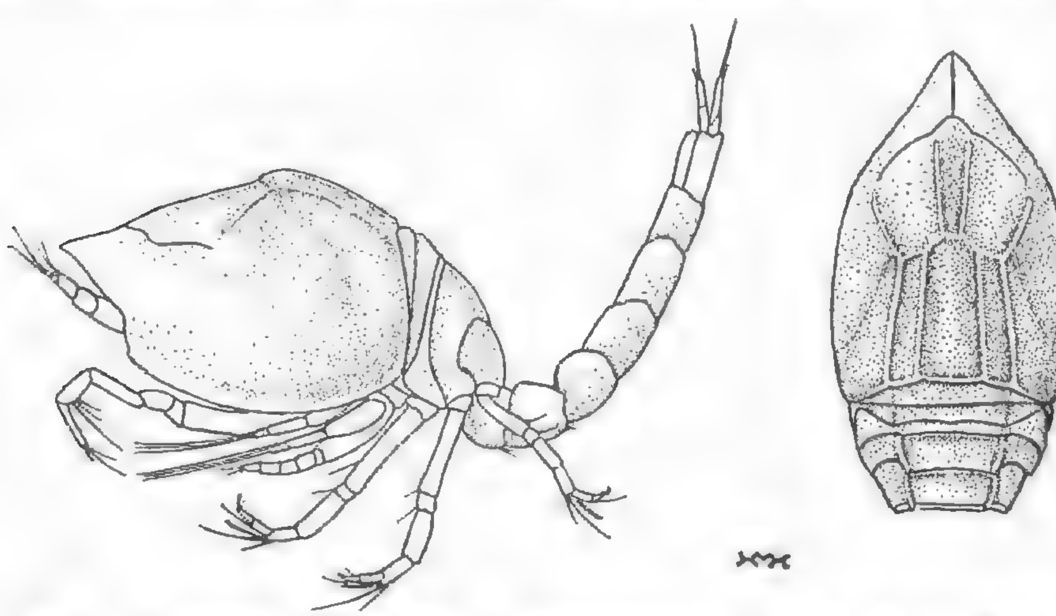

Fig. 39. *Gynodiastylis quadricristata*, type female; lateral view and cephalothorax from above (× 64).

the last-named four longitudinal ridges extend to the crassate hinder margin; sides with a shallow depression, the upper edge of which is defined by a fairly well-marked curved ridge, the lower by a feeble fold. Antero-lateral margin very shallowly and rather angularly concave; antero-lateral angle and margin immediately posterior to it with a few teeth. Pseudorostrum pointed in front, triangular when viewed from above or from the side; lobes meeting for a distance equal to one-fifth of length of carapace. Frontal lobe very wide; ocular lobe wider than long, without apparent lenses.

Pedigerous somites crowded, the first concealed on sides; third very short dorsally but pleural parts expanded fore and aft; fourth and fifth of equal length

dorsally, each as long as first three together, and with a pair of dorso-lateral carinae; indications of similar ridges are present on the other somites.

Pleon distinctly shorter than cephalothorax, the somites not differing much in length; sixth about half as wide again as long and two-thirds as long as fifth, telson obovate, subequal in length to sixth somite, without post-anal portion and with no discernible apical spines.

First antenna robust, the first joint of peduncle as long as second and third together, the second wider but not longer than third; flagellum short, two-jointed, and accessory flagellum minute.

Third maxilliped with basis equal in length to remaining joints combined and with a spine at inner distal angle; the other joints do not differ much in length.

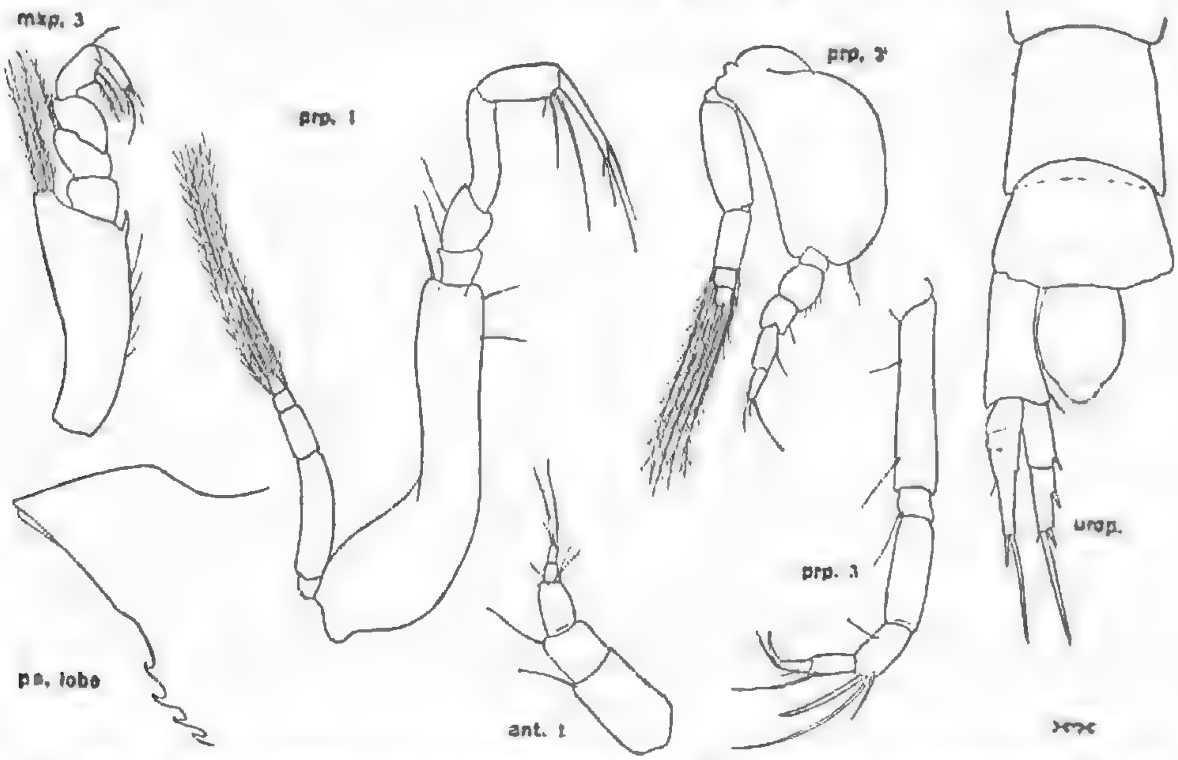

Fig. 40. *Gynodiastylis quadricristata*, type female; ps. lobe, pseudorostral lobe; ant., mxp. and prp., first antenna, third maxilliped and first to third peraeopods; urop., uropod with fifth and sixth pleon somites, and telson (all × 125).

First peraeopod short, the carpus reaching beyond antennal angle but not attaining level of apex of pseudorostrum; basis fully as long as rest of limb; propodus barely two-thirds as long as carpus, not as long as ischium and merus combined, and with three unequal inner distal setae, the longest about twice as long as the joint; dactylus longer than propodus.

Second peraeopod rather less than half as long as first, with the wide basis nearly half as long again as rest of limb; ischium distinct; merus subequal in length to propodus and longer than carpus or dactylus, which are of about the same length.

Third and fourth peraeopods with merus more than half length of basis and not much longer than carpus and propodus together; propodal seta slender, reaching beyond tip of distinctly separated dactylar claw; last of distal carpal setae stout not reaching to end of dactylus but preceding seta slender and attaining same level as that of propodus; fifth peraeopod two-thirds as long as fourth.

Uropod short and robust; peduncle barely longer than telson, little more

than twice as long as broad and as long as the subequal rami; endopod composed of two equal joints with one and two inner spines respectively; terminal spine, like the longer of the exopodal spines, four-fifths as long as the ramus.

Colour milk white. Length 1·36 mm.

Loc. Queensland: Noosa River, below Gympie Terrace, surface (I. S. R. Munro, Station T/44·1, 50 cm. 40 m. net, 9.12 p.m., Mar. 25, 1944). Type in South Australian Museum, Reg. No. C. 2682.

GYNODIASTYLIS BREVIPES sp. nov.

Female with developing marsupium. Integument calcified but thin; smooth and polished.

Carapace robust, boldly arched above; it is barely one-third of total length of animal, half as long again as pedigerous somites together; one-third as long again as deep and a little compressed; on each pseudorostral lobe a short longitudinal dorsal ridge runs from apex to ocular lobe and a second curved carina extends from the tip to just below posterior end of frontal lobe; on each side

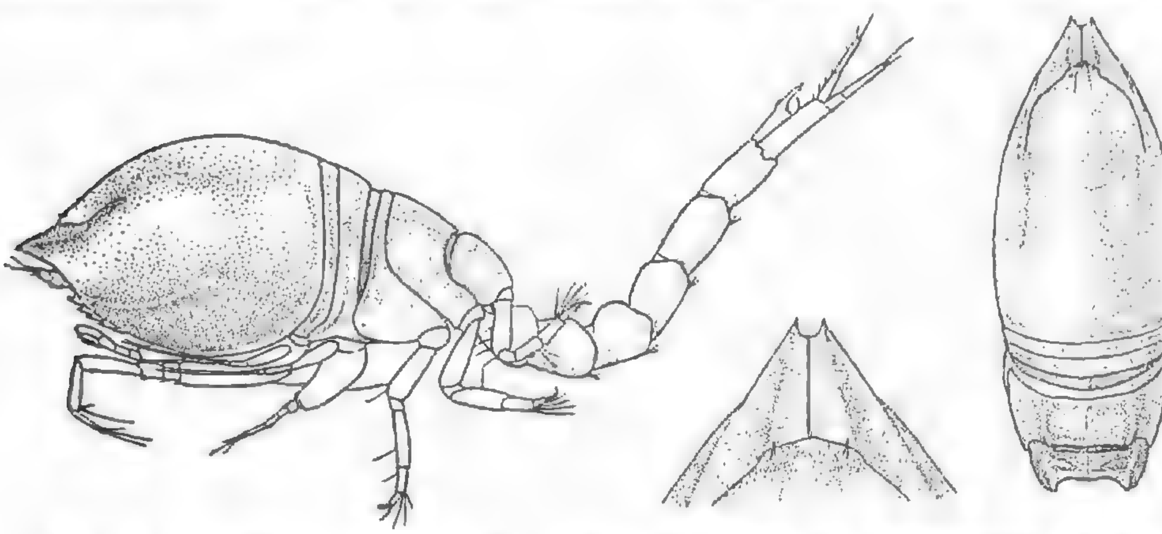

Fig. 41. *Gynodiastylis brevipes*, type female; lateral view and cephalothorax from above (× 31); pseudorostrum and ocular lobe (× 90).

of carapace are two further faint ridges forming the upper and lower boundaries of a somewhat flattened semi-oval area, not, however, well defined; there is a very shallow depression on each side of frontal lobe and a pair of short ridges on ocular lobe, which is armed with a pair of spinules. Antero-lateral margin sinuate, scarcely concave; a few strong teeth (serrations) behind antennal angle, the first constituting the angle itself. Pseudorostral lobes narrowed in front, acute as seen from the side, excavate from above, meeting for a distance equal to about one-ninth length of carapace. Frontal lobe well-marked; ocular lobe very short and broad, with three ill-defined oval areas representing the eyes.

Pleural parts in second pedigerous somite forwardly expanded, in third expanded in front and (more markedly) posteriorly, and in fourth backwardly produced; second and third peracopods not separated by a very pronounced interval; first to third somites each with a transverse fold; fourth (which is the longest dorsally) and fifth (which is not much shorter) each with a pair of strong longitudinal dorsal carinae, and with anterior and posterior margins between these ridges crassate.

Pleon a little shorter than cephalothorax, with somites one to six quite smooth; fifth not much longer than sixth, which is about as wide as long; telson equal in length to sixth somite, with distinct post-anal portion, armed with a pair of rather slender apical spines; an insignificant tooth on each side of terminal spines and a much larger tooth at base of post-anal part.

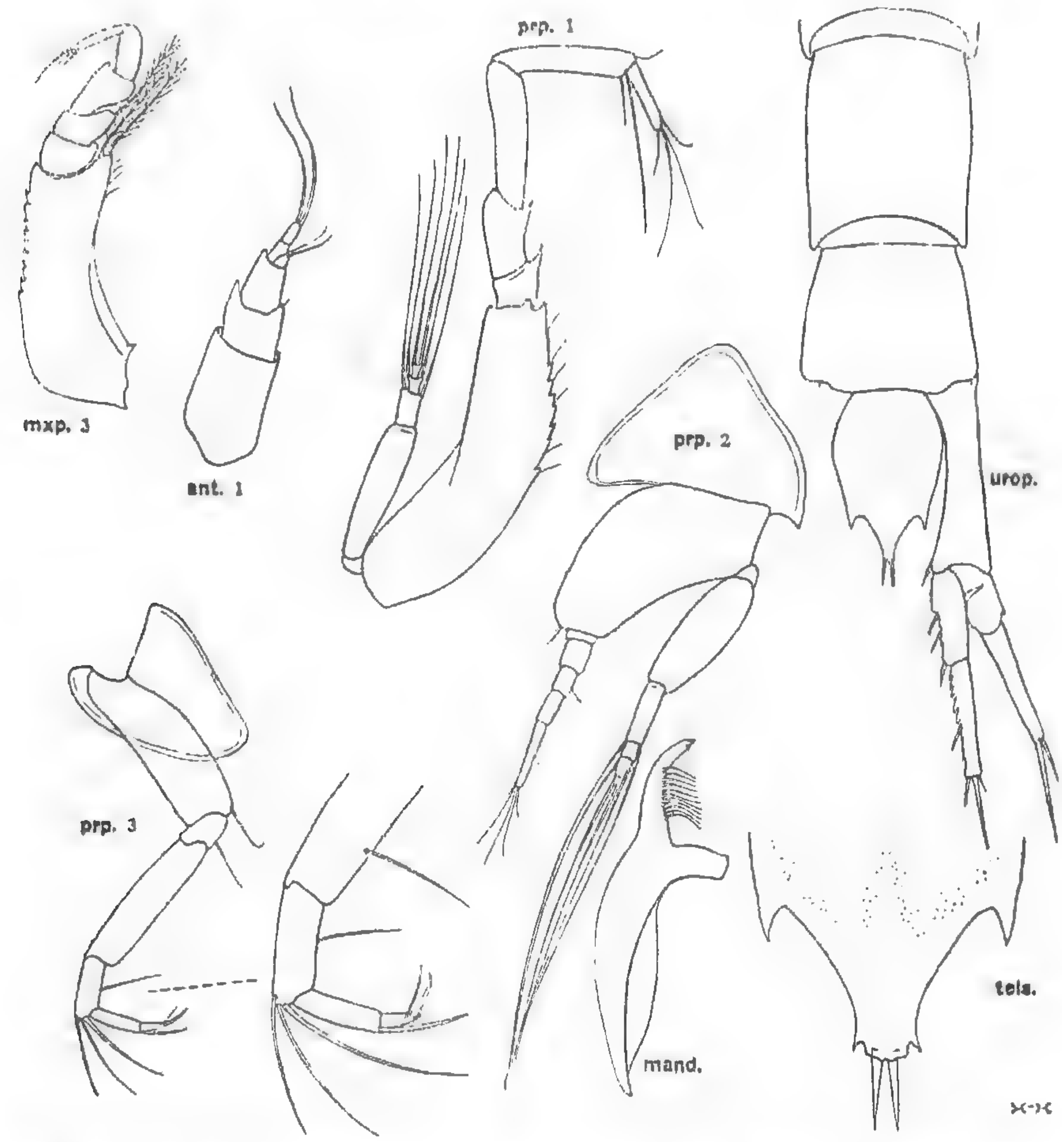

Fig. 42. *Gynodiastylis brevipes*, type female; ant., first antenna (× 125); mand., mxp. and prp., mandible, third maxilliped and first to third peraeopods (× 76; distal joints of third leg, × 125); urop., uropod with fifth and sixth pleon somites, and telson (× 76); tels., distal portion of telson (× 250).

First antenna stout and short; first joint of peduncle longer than second and third together; second subequal in length to third; flagellum two-jointed, and accessory lash very small.

Mandible of usual form with about eleven spines in the row; it is elongate and is as long as third maxilliped without dactylus.

Basis of third maxilliped only about one-seventh as long again as rest of limb; carpus, propodus and dactylus subequal in length, each longer than ischium or merus.

First peraeopod stout, not reaching much beyond apex of pseudorostrum when extended; basis serrate on inner margin, distinctly shorter than remaining joints together; ischium and merus (like basis) with a tooth at inner distal angle; carpus and propodus subequal in length, each twice as long as dactylus; only two or three propodal setae.

Second peraeopod shorter than third or fourth, with exopod (not including setae) as long as the basis, which is one-third as long again as the rest of limb; ischium distinct; merus, carpus and propodus not differing much in length, each about half as long as dactylus.

Second to fifth peraeopods moderately robust; merus shorter than basis, and much less than twice as long as carpus and propodus combined; carpus with three distal setae, all slender, the longest, like propodal seta, reaching to level of tip of slender dactylus.

Peduncle of uropod barely longer than telson, with an inner spine at distal end; endopod with inner margin serrate, a little longer than exopod which is equal in length to peduncle; two-jointed, the first joint with three inner spines and three-fourths as long as second, which bears two inner spines, the second distal; the long terminal spine is less than half the length of the ramus; exopod with longer of the unequal terminal spines more than half as long as the ramus.

Colour white. Length 3·1 mm.

Loc. New South Wales: 4 miles off Eden, 70 metres, in silt, type loc., K. Sheard, Oct., 1943); 4 miles off Port Hacking, 80 metres, on mud (K. Sheard, A. Trawl, May, 1944); Ulladulla, Brush Island, 45 fath., in fine silt on flathead grounds (D. Rochford, Jan., 1945). Type in South Australian Museum, Reg. No. C. 2656.

Two ovigerous females from the type locality are smaller than the type (2·7 mm.) and than adult females from Brush Island, but differ only in having the appendages slightly more slender, although the joints are of the same proportions.

GYNODIASTYLIS CONCAVA sp. nov.

Ovigerous female. Integument dull, with small but distinct reticulate patterning.

Carapace less than one-third of total length of animal, as wide as deep, one-third as long again as broad, and with each side deeply concave; the lateral hollow is somewhat quadrilateral and is margined below by a longitudinal ridge, its rear edge forms a transverse carina and its upper limit is defined by a dorso-lateral fold, which extends back quite to posterior margin of carapace; dorsum depressed between hinder third of dorso-lateral ridges, slightly rounded (almost flat) over frontal lobe; seen from above the carapace is subtriangular in shape, tapering to the front and broadest across branchial regions; viewed thus the outbent inferior edge is visible at the rear. Antero-lateral margin deeply concave, antennal angle subacute and inferior edge posterior to it finely serrate. Pseudorostrum subacute in front when viewed either from above or from the side, the lobes meeting for a distance equal to fully one-fifth of total length of carapace. Frontal lobe large, distinctly separated off; ocular lobe rather small, twice as wide as long, rounded and with three small, pale eyes.

Pleural parts of all pedigerous somites exposed, but those of first partly overlapped by anterior pleural lobe of second; third somite, like second, short dorsally, but moderately expanded fore and aft on sides, where it overlaps second in front; second and third peraeopods not very widely separated; there is a dorso-lateral carina on each side of fourth somite.

Pleon as long as cephalothorax, the anterior somites, like pedigerous, with obsolete granulation; subcylindrical excepting for sixth somite which is broadened posteriorly; fifth somite about half as long again as sixth, which is as wide as long; telson almost as long as sixth somite, tapering, without any abrupt constriction, only in distal third of length; postero-lateral margins serrate; there is a very short post-anal portion, with two terminal spines, rather stout, and flanked on each side by a smaller spine, anterior to which are one or two pairs of bristles.

First antenna with the first joint of peduncle about as long as second and third together, and third little longer than second (third much longer than second in *tumida*); flagellum two-jointed, only half as long as third peduncular segment, and accessory flagellum minute. Upper lip unusually elongate.

Fig. 43. *Gynodiastylis concava*, type female; lateral view and cephalothorax from above (× 35).

First peraeopod slender and rather long, the carpus reaching to level of apex of pseudorostrum; basis less than two-thirds as long as remaining joints together, and with a small tooth at inner distal angle and some serrations on sides; propodus elongate, not dilated, fully one-third as long again as dactylus, and not much shorter than propodus, which is almost half as long again as the combined lengths of ischium and merus; propodus with three unequal setae at distal end of inner margin, one of them longer than propodus; dactylus with several long terminal setae.

Basis of second peraeopod half as long again as rest of limb (which is abbreviated) and with two teeth at outer distal angle; ischium suppressed, merus serrate on inner edge, subequal in length to either carpus or propodus; the last-named is two-thirds as long as the dactylus, which has very slender setae, one of the terminal ones being longer than the joint.

Third and fourth peraeopods with basis shorter than rest of limb, and with merus about one-third as long again as carpus and propodus together; one of the two distal carpal setae is shorter and much stouter than the others and (unlike the latter and the propodal seta) does not reach to level of tip of dactylus; fifth peraeopod a little shorter than the others.

Peduncle of uropod stout, a little longer than the telson and than the rami, with a short inner spine at distal end and anterior to it a short seta; endopod

slightly longer than exopod, with a distinct suture marking off a proximal joint which is half as long as the rest of the ramus and a faint groove (but no actual suture) dividing the remainder into two portions equal in length; inner margin with only three spines, one at distal end of first joint, one at the aforementioned groove and one alongside the terminal spine, which is a little longer than that of exopod and as long as the proximal joint of its ramus.

Colour cream. Length 2·6 mm.

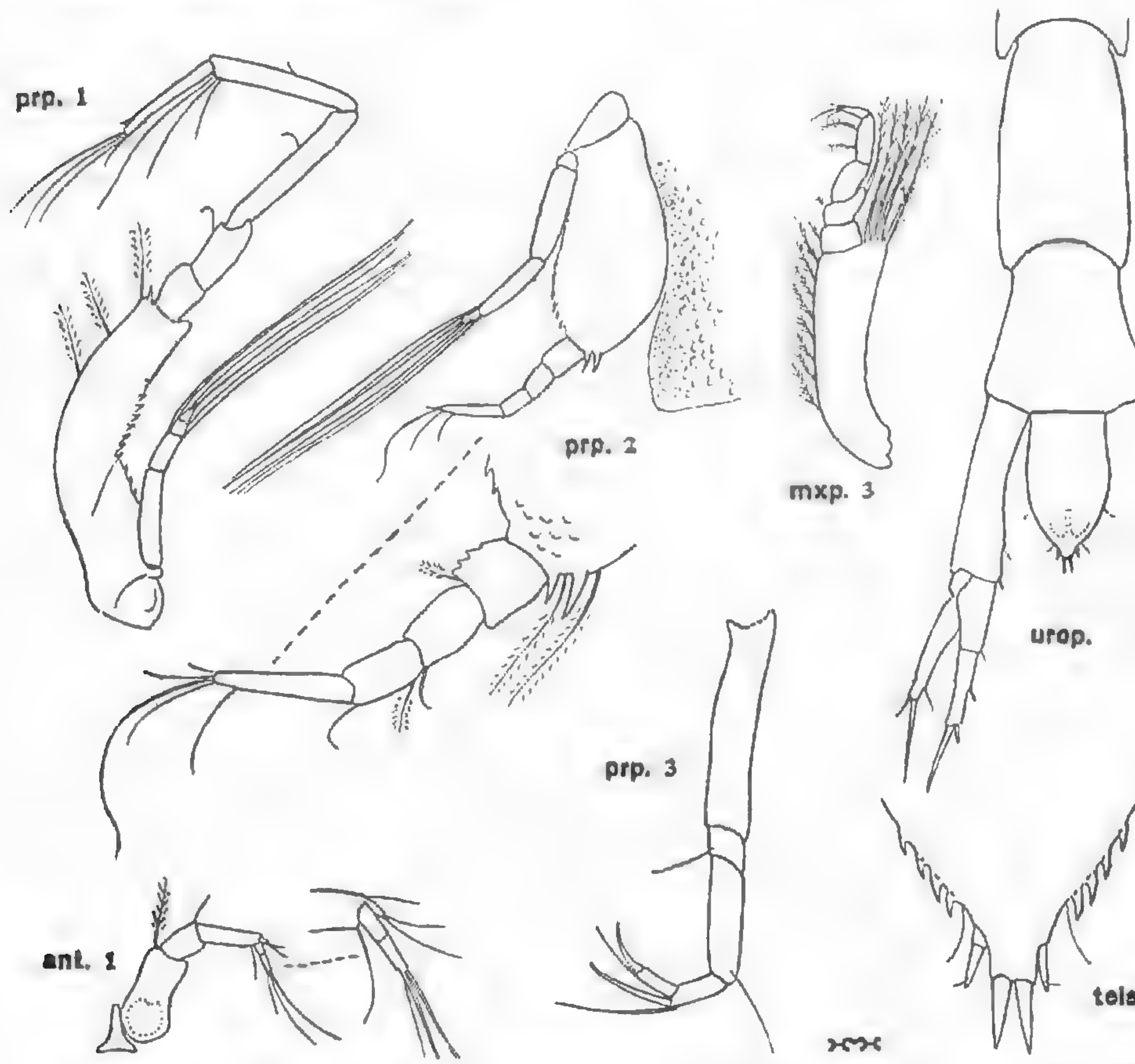

Fig. 44. *Gynodiastylis concava.* Type female; prp., first to third peraeopods (× 70; distal joints of second leg, × 150). Paratype ovigerous female; ant., first antenna and upper lip (× 70; flagella, × 150); mxp., third maxilliped (× 70); urop., uropod with fifth and sixth pleon somites, and telson (× 70); tels., distal end of telson (× 300).

Loc. New South Wales: 4 miles off Eden, 70 metres, in silt (type loc., K. Sheard, Oct., 1943). Tamasnia: off Babel Island, 39° 55′ S., 148° 31′ E., 0–50 metres ("Warreen" Station 29, Jan., 1939).

A single female comes from Tasmania; it has the marsupium not fully developed, but is 3·3 mm. in length, thus being larger than ovigerous females from New South Wales.

This species resembles *tumida* in some respects, but is separated by the different proportions of the appendages, the absence of lateral prominences on the dorso-lateral folds of the carapace of the adult, the different telson, etc.

GYNODIASTYLIS TUMIDA (Hale).

Paradiastylis tumida Hale, 1937, p. 66, fig. 3–4.

This species now falls into place with others of the genus in which the telson has a tapering post-anal portion and lateral serrations. The mature male, previously unknown, has no pleopods.

Examples from St. Vincent Gulf, South Australia, and Sydney Harbour, New South Wales, as previously described, resemble each other closely. Some

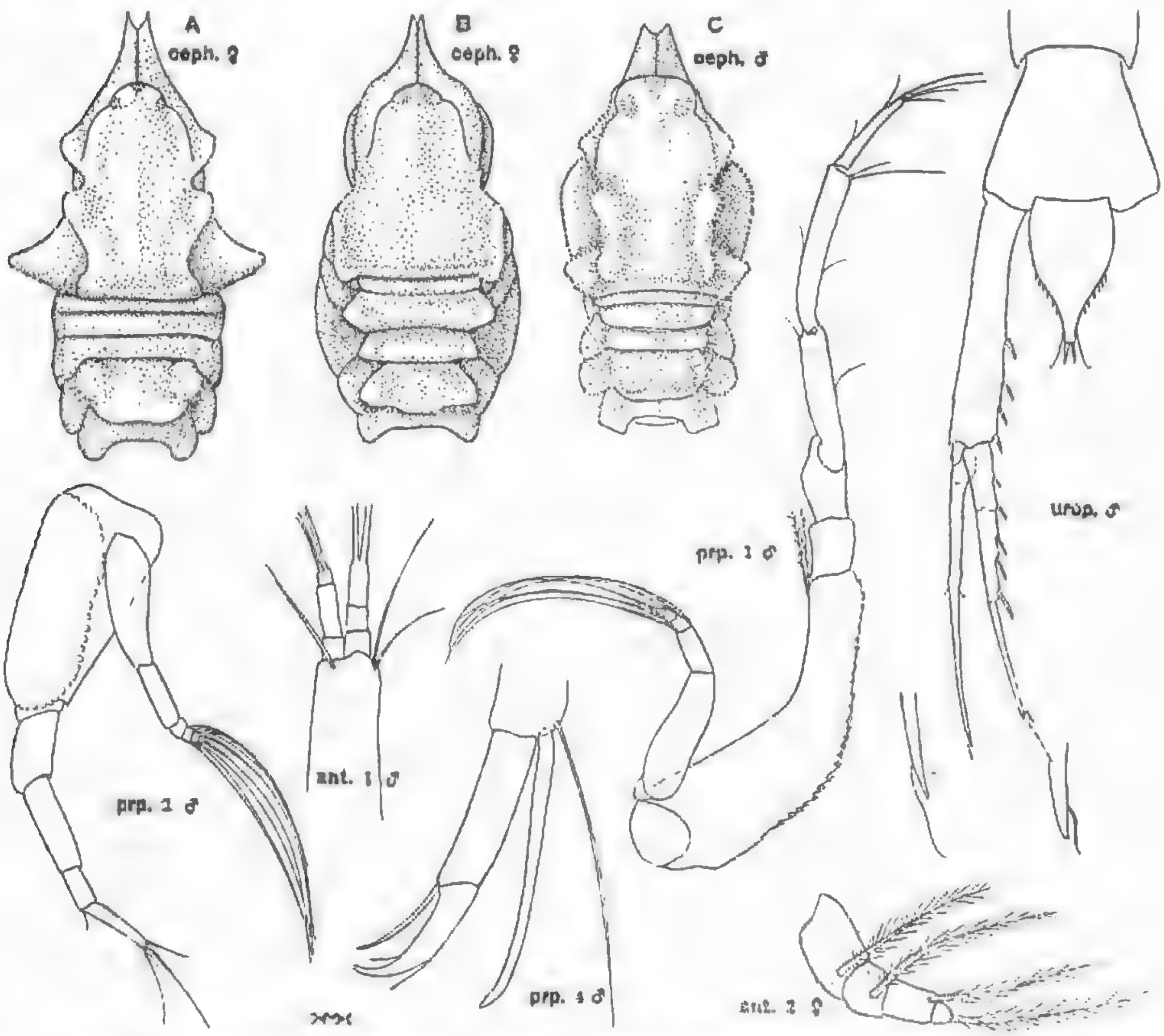

Fig. 45. *Gynodiastylis tumida.* Subadult female from Tasmania; A, ceph., cephalothorax from above (× 25); ant. 2, second antenna (× 120). B, ceph., Cephalothorax of ovigerous female from Spencer Gulf, South Australia (× 25). Adult male from Spencer Gulf; C, ceph., cephalothorax from above (× 25); ant. 1, flagella of first antenna (× 250); prp. 1–2, first and second peraeopods (× 65); prp. 4, distal joints of fourth peraeopod (× 250); urop., uropod with sixth pleon somite and telson (× 65).

specimens from Tasmania (Kettering, 2–3 fath., W. S. Fairbridge, submarine light, Jan., 1945). and others from Spencer Gulf, South Australia (Western Shoal and Port Lincoln, K. Sheard, submarine light, tow-net, Feb., 1938, and Feb., 1944) exhibit quite considerable differences in the shape of the carapace, but as the fundamental arrangement of the folds and projections is the same in all, and as all have the uropods and other appendages very similar they are provisionally regarded as variants of the one species although it may well be

that more complete series of the adults of both sexes will lead to the recognition of three separate species.

Even quite juvenile females of all have the lateral prominences of the dorso-lateral folds of the carapace; normally in the second leg the ischium (not made out in the type) is distinct, though it is short and collar-like; the wide basis is always distinctly shorter than the rest of limb and the propodus is shorter than the dactylus. The second antenna of the female is four-jointed the first segment as long as second and third together, the fourth small.

Tasmania. A young male and female, and a female with developing marsupium have the carapace as shown in fig. 45, A; the dorso-lateral folds are much as previously illustrated for the ovigerous female, although the most anterior of their lateral projections are less swollen; the rounded elevation near hinder margin on each side, however, is here strikingly different, being greatly enlarged, while the fourth pedigerous somite has the pair of dorso-lateral ridges swollen and elevated. The carapace and lateral parts of pedigerous somites bear distinct granules. Apart from the character of the carapace the juvenile male differs from the young male previously recorded, and from the adult male described below, in having the endopod of the uropod distinctly three-jointed instead of two.

Spencer Gulf, South Australia. An ovigerous female has the integument indurated but translucent, quite unlike that of the white or pearly exoskeleton of the type examples and the Tasmanian specimens; it has the anterior part of the dorso-lateral fold of carapace somewhat swollen as in the type, but the posterior portion is cristate, projecting laterally and overhanging the not very conspicuous tumidity on the side (fig. 45, B); the curved ridge which runs forward from the last-named elevation is low and rounded in the examples previously recorded and in the Tasmanian material, but in this female it is almost cristate and is visible when the animal is viewed from above; the lateral concavity is more pronounced than in the types. The second to fourth pedigerous somites have the dorsum elevated transversely and produced on each side to form a dorso-lateral tumidity which is almost cristate on the fourth somite.

The only fully mature males in hand were taken in this Gulf.

Adult male. Integument finely granulate, calcified, but semi-transparent.

Carapace one-third of total length of animal and two-thirds as long again as pedigerous somites together; it is less than twice as long as deep, and is broader than deep because of the great prominence of the lower lateral ridge (see fig. 45, C); the three dorso-lateral projections are much developed, as is also the elevation lower down on side of carapace from which curves forward the lower carina. Antero-lateral margin excavate to form a distinct antennal notch; antennal angle obtuse, the margin below broadly rounded. Pseudorostrum slightly downbent (thus foreshortened in fig. 45, C.) obliquely truncate anteriorly; lobes meeting for a distance equal to more than one-fifth of length of carapace. Frontal lobe with sutures fused; ocular lobe large and tumid, twice as wide as long, with three prominent pale lenses.

The large fourth pedigerous somite has a pair of dorsal tumidities.

Pleon as long as cephalothorax; telson about as long as sixth somite, with post-anal portion rather more tapered than in female and with two apical spines, flanked by a pair of bristles inserted infero-laterally; lateral serrations small, but distinct.

As in the female the last peduncular joint of the first antenna is rather long; both flagella appear to be three-jointed (see fig. 45, ant. 1), and the accessory is not much shorter than the main lash.

The second antenna is so generously furnished with sensory hairs that the

whole appendage resembles a dense brush; the flagellum is very short, not as long as last peduncular joint, and consists of seven segments.

Mandible with nine or ten spines in the row.

First peraeopod with basis two-thirds as long as rest of limb; carpus (which attains level of antennal angle) shorter than propodus, which is nearly twice as long as dactylus; the propodal setae are not very long and number only two or three.

Second peraeopod with ischium distinct and with carpus distinctly longer than merus, and more than twice as long as propodus, which is almost two-thirds as long as dactylus.

Third to fifth peraeopods with one very stout and one bristle-like carpal seta as in female (fig. 45, prp. 4).

The first to fourth legs bear exopods.

Uropod relatively longer than in female; peduncle nearly twice as long as telson and with four inner spines in distal half; endopod nearly two-thirds as long as peduncle, two-jointed, the first segment three-fourths as long as second (my assumption that the two-jointed condition in the young male previously described was necessarily due to immaturity was too premature); there are two spines on inner edge of first joint, three on second, and a terminal spine three-fourths length of ramus; exopod with a stout and long terminal spine, which is as long as ramus but is not distinctly marked off from it; the ramus, not including spine in the length, is a little shorter than endopod.

Length 2·8 mm.

GENUS DICOIDES nov.

Like *Gynodiastylis* but (1) first peraeopod massive in both sexes, reaching for greater part of its length in front of carapace and with propodus as long as, or longer than, the basis; (2) exopods present on first four pairs of peraeopods of female.

Genotype *Dic brevidactylum* Hale.

In the genotype the thoracic exopods are all small; in the two other species referred to the genus those of the first and second peraeopods are larger than the others but are still rather poorly developed. The basis of the second leg, like that of the first, is relatively short. The telson is subcylindrical, with no distinct post-anal portion, its lateral margins are without serrations or lateral spines, and the terminal spines are rudimentary in both sexes. The third maxilliped is as in *Gynodiastylis*, with the ischium not dilated as it is in *Dic*.

KEY TO SPECIES OF *DICOIDES*

1. Dactylus of first peraeopod longer than propodus .. .. *areolata* sp. nov.
   Dactylus of first peraeopod less than half as long as propodus .. .. .. 2.
2. Rostral siphons very long, at least half length of carapace. Telson much longer than sixth pleon somite .. .. *brevidactyla* (Hale).
   Rostral siphons short. Telson much shorter than sixth pleon somite .. *fletti* sp. nov.

DICOIDES AREOLATA sp. nov.

Ovigerous female. Integument lightly calcified but opaque. Carapace small, only one-fourth of total length of animal and one-third as long again as pedigerous somites together; it is three-fourths as long again as deep, and barely wider than deep; on each side there is a shallow pit behind frontal lobe, and dorso-laterally

an elongate rounded ridge running from near front of pseudorostrum to beyond frontal lobe; this ridge is most distinct when the carapace is viewed from above; the sides are slightly concave, and posterior to the hollow are marked with faint striae. Antero-lateral margin shallowly concave; antero-lateral angle obtuse and margin posterior to it finely serrate (fig. 47, ps. lobe). Pseudorostrum subacute as seen from the side and from above, the lobes meeting in front of ocular lobe for a distance equal to almost one-sixth of length of carapace, gaping slightly at extreme apex. Frontal lobe distinctly defined, the sutures not fused; ocular lobe rounded, tumid, wider than long, with a pale area on each side apparently representing the eyes.

Third to fifth pedigerous somites projecting backwards on side, the third and fourth dorsally longer than the other somites; first to fourth each with a well-marked transverse furrow.

Fig. 46. *Dicoides areolata*, paratype female; lateral view and cephalothorax from above (× 28).

Pleon distinctly longer than cephalothorax, with somites subcylindrical; fifth somite more than one-third as long again as sixth which is somewhat dilated at distal end, where it is almost as wide as long; telson longer than any of the other somites and three-fourths as long again as sixth.

First antenna with third peduncular joint relatively long, three-fourths length of first, but not much longer than second; flagellum two-jointed and accessory flagellum very small.

Mandible with about ten spines.

Third maxilliped with basis as long as rest of limb; serrate on inner margin; ischium with a small inner distal spine; propodus and carpus subequal in length, each longer than dactylus or merus.

First peraeopod with merus reaching beyond level of antennal angle, more than half of total length of the limb projecting beyond anterior end of carapace; basis only one-fourth of length of remaining joints together; carpus two and one-half times as long as merus and not very much longer than the propodus, which is widest at distal end; dactylus extraordinarily massive, the longest of the joints

of this limb, and as long as merus and carpus together; terminal dactylar setae short, one stouter than the others; carpus, propodus and dactylus patterned with transparent circular areas (fig. 47, prp. 1).

Second peraeopod long and slender; basis not much longer than merus and carpus together; ischium suppressed; merus elongate, as long as propodus and

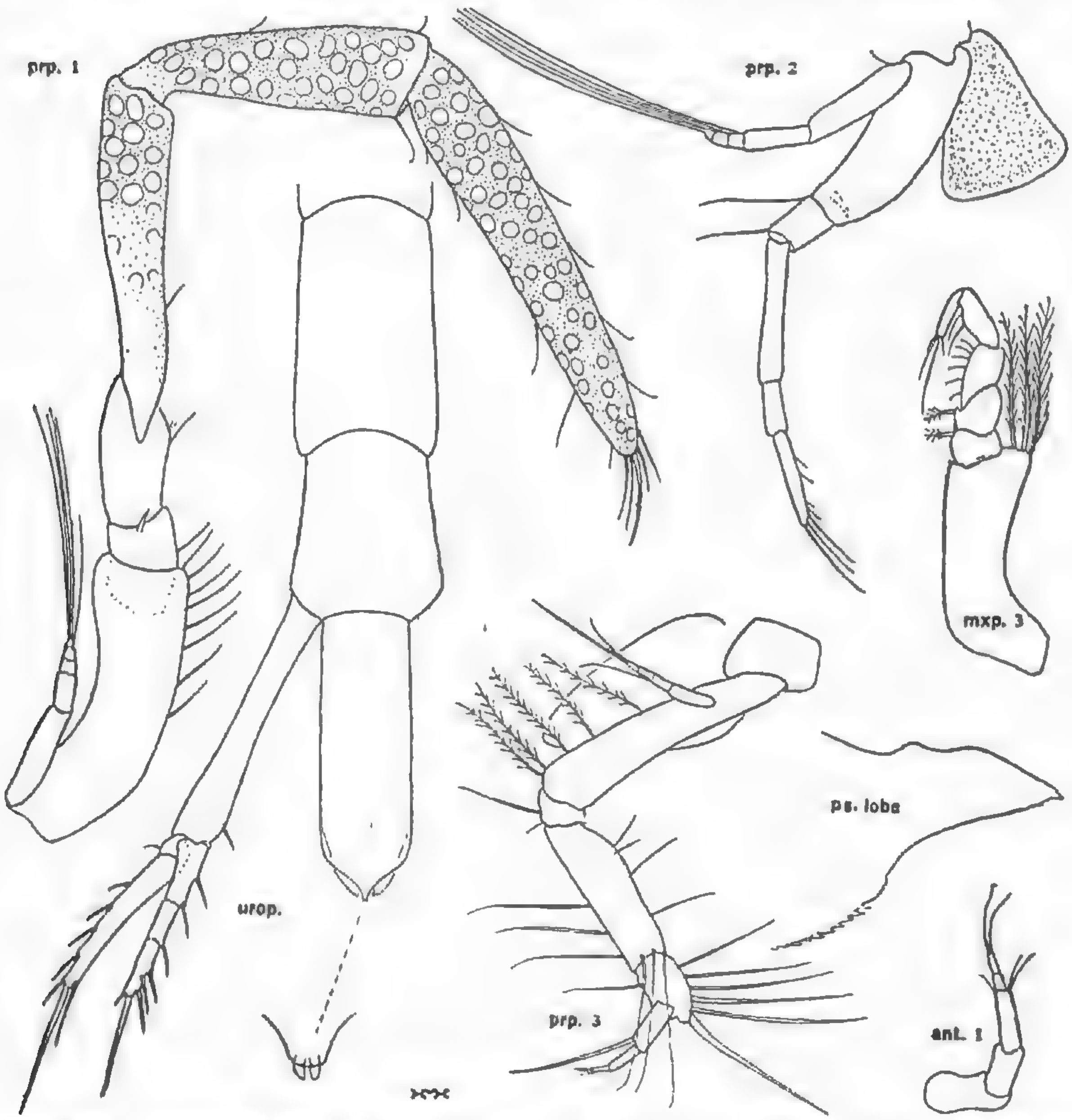

Fig. 47. *Dicoides areolata*, paratype female; ps. lobe and ant., pseudorostral lobe and first antenna; mxp. and prp., third maxilliped and first to third peraeopods; urop., uropod with fifth and sixth pleon somites, and telson (× 70; distal end of telson, × 240).

dactylus together; dactylus less than twice length of propodus and with longest distal setae as long as the joint.

Fourth peraeopod shorter than second, and fifth considerably shorter than fourth; in the third and fourth pairs the merus is almost as long as carpus, propodus and dactylus together; exopods of these limbs with peduncle and three-jointed flagellum furnished with three setae; the propodal seta and the distal carpal setae reach well beyond tip of dactylus.

Peduncle of uropod slender, not quite as long as telson, unarmed except for a single inner spine near distal end; exopod nearly three-fourths as long as peduncle, and longer than endopod, with five slender spines on outer margin, one (subdistal) on inner, and a terminal spine shorter than its second joint; endopod divided into three segments, with two, one and three inner spines respectively; distal and proximal joints subequal in length, each longer than second joint; terminal spine (which has a small outer spine near its base) as long as second and third joints together.

Colour cream. Length 3·0 mm.

Adult male. Differs little from the female excepting for the following:

First peraeopod shorter, the carpus reaching only to level of apex of pseudorostrum, and pleon more slender. The telson, as in the female, has only rudimentary terminal spines.

The second antenna has the flagellum a little longer than the peduncle and composed of eleven to twelve joints.

Basis of third maxilliped slightly longer than rest of limb; serrate on inner edge.

The first to fourth peraeopods have well-developed exopods.

Uropod with peduncle distinctly longer than telson; endopod almost as long as exopod, and two-jointed but with a third segment (comparable to that of female) marked off by a fused suture; there is one inner spine on peduncle as in female and the inner spines of endopod segments are three or four, two and two.

Length 2·6 mm.

Loc. New South Wales: 4 miles off Eden, 70 metres, in silt (K. Sheard, Oct., 1943); Ulladulla, Brush Island, 45 fath., in fine silt on flathead grounds (type loc., D. Rochford, Jan., 1945). Types in South Australian Museum, Reg. No. C. 2700–2701.

The remarkable structure of the first peraeopod is a characteristic feature; this and the long setae of the posterior peraeopods, together with the elongate telson, are distinctive.

A female from off Eden, 3·5 mm. in length and with developing marsupium was dissected and figured.

DICOIDES BREVIDACTYLA (Hale).

Dic brevidactylum Hale, 1937, p. 69, fig. 6–7.

Ovigerous female, New South Wales form. It would seem that this bears the same relation to the types as do eastern coast examples of some of the other species which occur also in South Australia. One may cite for instance *Cyclaspis cretata* (Hale, 1944, p. 91) and *Bodotria maculosa* (Hale, 1944a, p. 226); it is possible that the differences may prove constant enough to warrant subspecific rank.

In this case the thorax and its appendages are as in the South Australian types, but the difference lies in a general elongation of the animal. The female is slightly smaller than the type (2·5 mm. as against 2·7 mm.) but the telson is relatively longer, reaching beyond the distal end of peduncle of uropod, while the first five pleon somites together are equal in length to the cephalothorax instead of shorter than it. The branchial siphons are remarkably long, about three-fourths the length of carapace. In the first peraeopods one of the terminal dactylar setae and one near distal end of propodus are stout and almost spine-like.

Small exopods are present on the first to fourth peraeopods; these are similarly developed in the type female. Although all have peduncle and flagellum they are, as previously noted, quite rudimentary, with short setae; those of the first pair

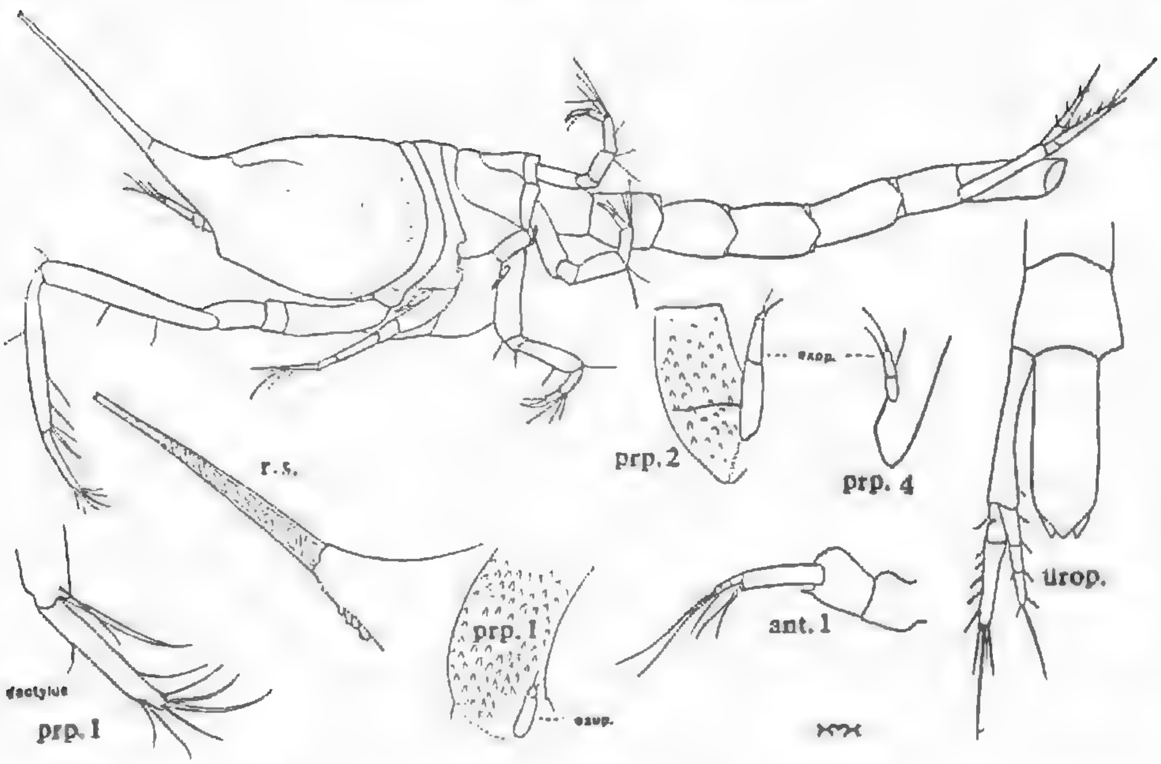

Fig. 48. *Dicoides brevidactyla*, ovigerous female of New South Wales form; lateral view of whole animal (× 39); r.s., rostral siphon (× 60); ant., first antenna (× 95); dactylus prp. 1, dactylus of first peraeopod; exop., exopods of first, second and fourth peraeopods (× 95); urop., uropod with sixth pleon somite and telson (× 58).

are little, if any, larger than those of the third and fourth legs and are less than half the length of the exopod of the second leg.

Loc. New South Wales: 4 miles off Eden, in silt, 70 metres (K. Sheard, Oct., 1943).

Although no eye is apparent in examples preserved in alcohol, it is represented by a spot of vivid red pigment in South Australian specimens freshly preserved in formalin.

DICOIDES FLETTI sp. nov.

Ovigerous female. Integument calcified, with fine but distinct reticulate patterning, and with well-spaced granules on carapace.

Carapace relatively small, not much more than one-fourth of total length, and little longer than pedigerous somites together; seen from above it is widest across the branchial regions; its depth is three-fourths its length and is equal to greatest breadth; there is an obsolete median carina on the back, while on each side a dorso-lateral, horizontal, elongate tumidity runs backwards from the pseudorostral lobes for greater part of the length of the carapace; below this elevation is a shallow depression; anterior margin and inferior edge finely serrate. Antero-lateral margin a little sinuate, scarcely at all concave, and antero-lateral angle widely rounded, serrate. Pseudorostral sutures fused; lobes meeting in front of ocular lobe for a distance equal to about one-seventh length of carapace, anteriorly widely gaping.

Pedigerous somites one to three wider than carapace; the third somite is shorter on the dorsum than any of the others, but the pleural parts of second and

third somites are considerably expanded laterally and are longer than in the others.

Pleon stout, not very much shorter than cephalothorax; fifth somite about one-fourth as long again as sixth, which is little longer than wide; telson less than two-thirds as long as sixth somite, subcylindrical rather than subtriangular, with two tiny apical spines, and with lateral margins weakly serrate.

First antenna somewhat geniculate between second and third segments of peduncle; first joint with inner margin strongly serrate; second joint short, less

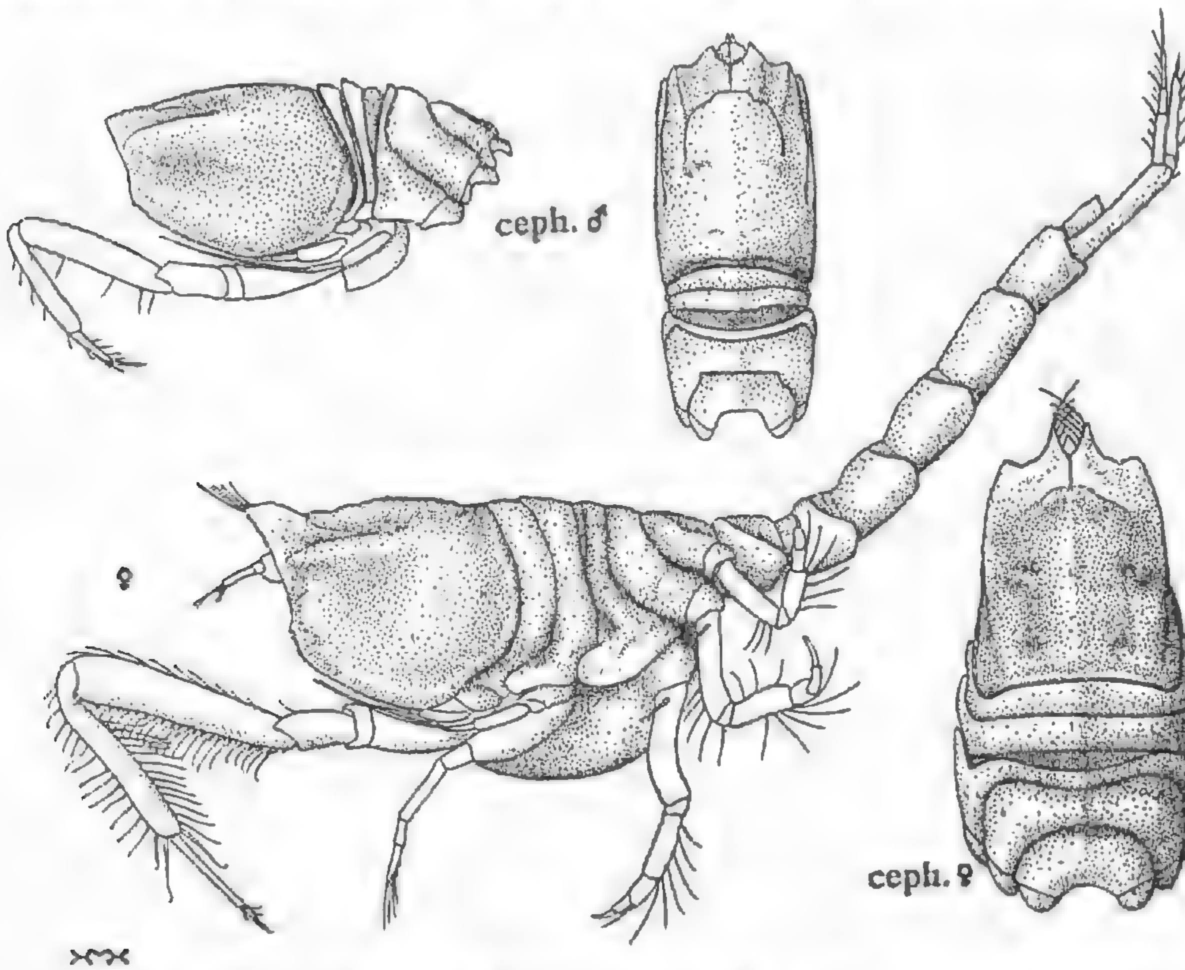

Fig. 49. *Dicoides fletti*. Type female; lateral view and (ceph.) cephalothorax from above. Paratype subadult male; ceph., cephalothorax from the side and from above (all × 15).

than half as long as the third, which is long (subequal in length to first); flagellum three-jointed, the first segment twice as long as second and third together; accessory lash three-jointed and longer than first segment of main flagellum.

Second antenna three-jointed.

Third maxilliped with basis shorter than rest of appendage, somewhat expanded distally, but scarcely produced forwards; propodus subequal in length to dactylus and not as long as merus and carpus together; exopod absent.

First peraeopod massive, the merus reaching to anterior margin of carapace, fully two-thirds total length of the limb extending beyond this level; basis short, less than one-fourth as long as rest of limb; carpus as long as basis, ischium and merus together, less than one-fourth as long again as propodus, with margins dentate and furnished with long setae; propodus similar in structure to carpus and with three or four of the distal setae conspicuously stouter than the others;

dactylus narrow, subcylindrical, distally with several special setae and a strong, irregularly serrate claw (top left in fig. 50).

Second peraeopod with basis serrate on outer margin, not as long as remaining joints together; ischium obsolete; carpus slender, two and one-half times as long as merus, and nearly half as long again as propodus and dactylus together; propodus fully three-fourths as long as dactylus, which bears a series of slender setae but no spine.

Third and fourth peraeopods robust, each with small two-jointed exopod;

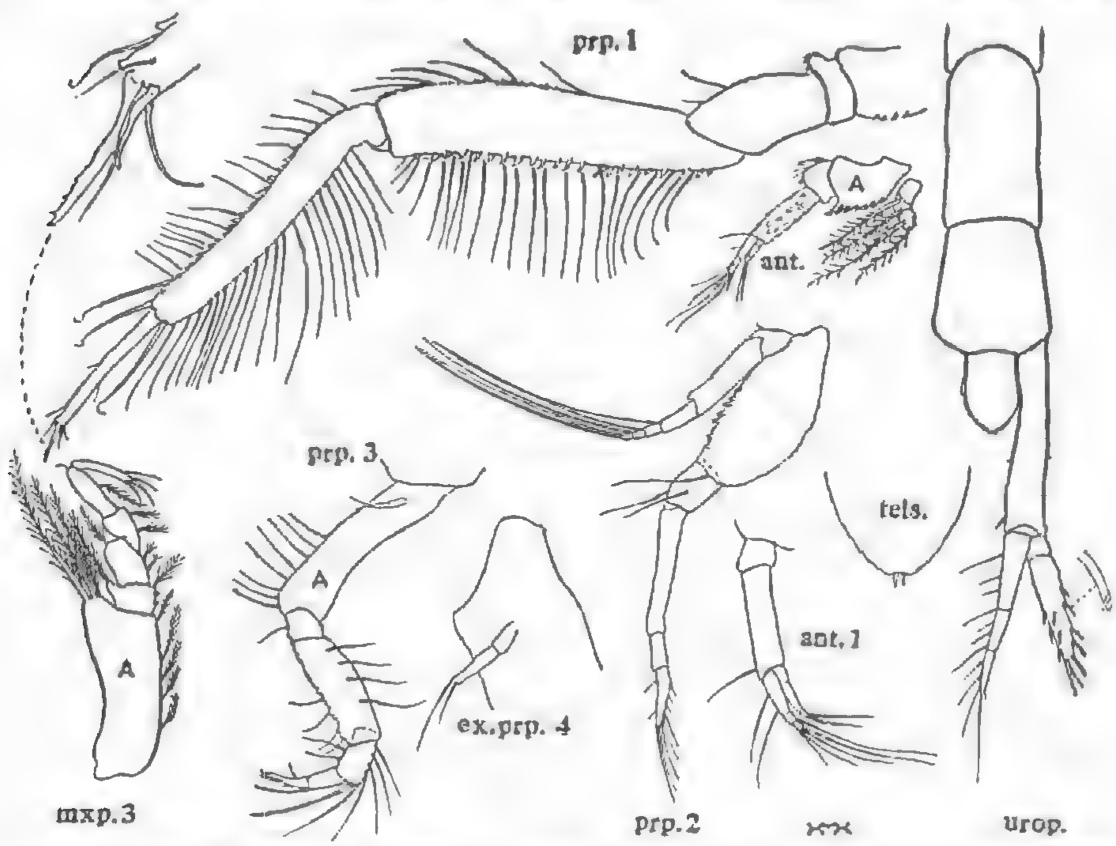

Fig. 50. *Dicoides fletti*, type and (A) paratype ovigerous females; ant., antenna (× 58); mxp. and prp., third maxilliped and first to third peraeopods (× 30; dactylar claw of first leg, × 94); ex. prp. 4, exopod of fourth peraeopod (× 94); urop., uropod with fifth and sixth pleon somites and telson (× 30); tels., distal end of telson (× 94).

basis not much shorter than rest of limb; merus as long as the three terminal joints without dactylar claw; fifth peraeopod the same size excepting that basis is a little shorter.

Peduncle of uropod nearly two and one-half times as long as telson, and fully as long as fifth pleon somite; endopod five-sixths as long as peduncle, one-fourth as long again as exopod, with unequal inner setae (see figure) and with a long terminal seta, half the length of ramus; it is three-jointed, the proximal segment almost as long as the other two (which are subequal in length) together; exopod with longitudinal rows of stout spines, the terminal ones reaching to level of distal end of endopod.

Colour white. Length 5·3 mm.

Subadult males. The carapace is not dilated across the branchial regions and the upper edge of the elongate dorso-lateral tumidity is more ridge-like; also more distinctly marked is a ridge-like fold on each pseudorostral lobe in front of eye lobe; the ocular lobe is distinctly delineated.

First and second pedigerous somites shorter than in female, but nevertheless longer dorsally than third, which is reduced to a narrow strip, but has the pleural parts well expanded backwards.

The first to fourth peraeopods bear moderately well-developed exopods, although the peduncle is barely wider than in anterior pairs of female; those of the third and fourth pairs have the setae not fully developed.

There is no trace of pleopods.

Length 4·6 mm. and thereabouts.

Loc. Tasmania: Babel Island, 39° 55′ S., 148° 31′ E., 25 metres, inshore station, surface (type loc., "Warreen" Station 29, N. 200, Jan., 1939). New South Wales: off Eden, 30 and 60 metres, in coarse sand and in silt (K. Sheard, A. Trawl and submarine light, Oct., Nov., and Dec., 1943); 4 miles off Port Hacking, 80 metres, on mud (K. Sheard, A. Trawl, May, 1944); Ulladulla, 75 metres (K. Sheard, A. Trawl, June, 1944). Type female in South Australian Museum, Reg. No. C. 2341.

This easily recognized species is named after Capt. A. Flett, Master of the "Warreen."

The dactylus of the first peraeopod is shorter in immature males and females than it is in the adult; also the marginal setae of the limb are sparse, but this applies also to some of the almost mature examples, and to ovigerous females from Ulladulla, which are smaller (5 mm.) than the type. The reticulate patterning is always distinct on the carapace, but the sparse granulation is not constant.

As in some species of *Gynodiastylis* pellucid spots, like those often occurring in *Campylaspis*, etc., are apparent on the carapace of a few examples.

The first antennae often have a prominent squamose sculpturing, particularly on third peduncular joint; the accessory flagellum may be slightly shorter than in the type (fig. 50, A) and only as long as the long first joint of main lash.

The median contact length of the pseudorostral lobes varies slightly.

Genus ALLODIASTYLIS Hale.

Allodiastylis Hale, 1936, p. 426, and 1937, p. 72.

The main distinguishing features are the slender upturned pseudorostrum, furnished with long setae at the tip, of the female and young male, and the character of the first antenna. The latter is long for the group (about half as long as carapace in the female) and has the first and second joints of the peduncle dilated and together not longer than the elongated third segment.

In combination with these characters the female completely lacks thoracic exopods and the telson is elongate, subcylindrical, and with no definite post-anal part. The second antenna of the female projects (relatively) well beyond the anterior margin of the carapace, it is apparently four-jointed, but the sutures of the terminal conical part, though discernible, do not separate distinctly the last three joints (see fig. 56, ant. 2). The first peraeopod is moderately long, with the dactylus normal for the family, and the propodus and carpus subequal in length. The most distal of the carpal setae of the third to fifth peraeopods is not very stout and is not shorter than the other or others.

The distal spines on the telson of the adult male (as known in two of the species) are long and bristle-like. This separates the male from that of all related genera except *Zimmeriana*, where similar sexual dimorphism occurs, but there the first antenna and first peraeopod are distinctive.

The endopod of the uropod is two-jointed in both sexes of the four species which fall here. The first antenna exhibits some variation. In *hirtipes* and

johnstoni spp. nov. it is much as in the genotype but in *tenuipes* sp. nov. the first two segments are dilated to a greater extent and resemble more the condition found in *Sheardia*.

The gap between second and third peraeopods varies in the species, as in *Gynodiastylis*.

The integument is calcified and brittle and is of a chalky, somewhat opalescent appearance in the female. It is translucent in the adult male, in which, as previously described, the carapace differs from that of the female and young male to an extraordinary degree.

KEY TO SPECIES OF *ALLODIASTYLIS* (FEMALES)

1. Rami of uropod equal in length .. .. .. *hirtipes* sp. nov.
   Exopod of uropod much longer than endopod .. .. 2.
2. Uropod with peduncle not longer than telson and with segments of endopod subequal in length .. .. *johnstoni* sp. nov.
   Uropod with peduncle longer than telson and with first segment of uropod much shorter than second .. .. 3.
3. First antenna with first two segments of peduncle greatly dilated (each as deep as long) and with flagellum more than half as long as third peduncular joint). Propodus of second peraeopod more than half as long as dactylus. Posterior limbs slender, the third longer than carapace .. .. *tenuipes* sp. nov.
   First antenna with proximal segments moderately dilated (each longer than deep) and with flagellum less than half as long as third peduncular joint. Propodus of second peraeopod less than half as long as dactylus. Posterior limbs not unusually slender, the third shorter than carapace .. .. *cretata* Hale.

ALLODIASTYLIS HIRTIPES sp. nov.

Ovigerous female. Integument with sparse, tiny granules, thickest on carapace, but present also on pedigerous and anterior pleon somites.

Carapace less than one-third of total length of animal, as deep as broad, and a little more than half as long again as wide; it has an elongate swelling (dorsolateral fold) immediately below the frontal lobe, a small, rounded tumidity at each rear corner of frontal lobe and the median portion of last-named elevated and rounded; posterior to the frontal lobe the dorsum is concave, the hollow emphasized by swollen lateral edges; on the sides is a large shallow depression. Antero-lateral margin very shallowly excavate; antero-lateral corner angularly rounded, armed with small denticles which continue along almost whole length of inferior margin. Pseudorostrum long, with spaced spinules below, very narrowly truncate in front; lobes meeting in front of ocular lobe for a distance equal to about one-third of total length of carapace. Frontal lobe broad; ocular lobe short, more than twice as wide as long, with no distinct lenses.

Pedigerous somites together more than half as long as carapace, not differing very conspicuously in length on the back; second with pleural parts produced forwards as small lobe; third produced fore and aft on the side, the second and third peraeopods being well separated.

Pleon narrow, shorter than cephalothorax; fifth somite not much longer than sixth, which is somewhat broadened posteriorly, where it is slightly wider than long; telson slender, three-fourths as long again as sixth somite, with lateral margins serrate for greater part of length and with a pair of rudimentary spines at apex, flanked on each side by a similar lateral spine and a bristle.

First antenna much as in genotype; flagellum one-third as long as third peduncular segment, two-jointed, the first joint somewhat longer than the three-segmented accessory lash.

Mandible with the usual nine to ten spines.

Third maxilliped with basis not a great deal shorter than rest of limb; carpus longer than any other of remaining joints; propodus and dactylus of equal length.

Basis of peraeopods with long setae which hold a dense matting of flocculent material. First leg, when extended, with carpus reaching beyond antennal angle, and dactylus beyond level of front of pseudorostrum; basis half as long as remainder of limb, its distal end encircled with stout teeth; propodus subequal in length to carpus and one-fourth as long again as dactylus.

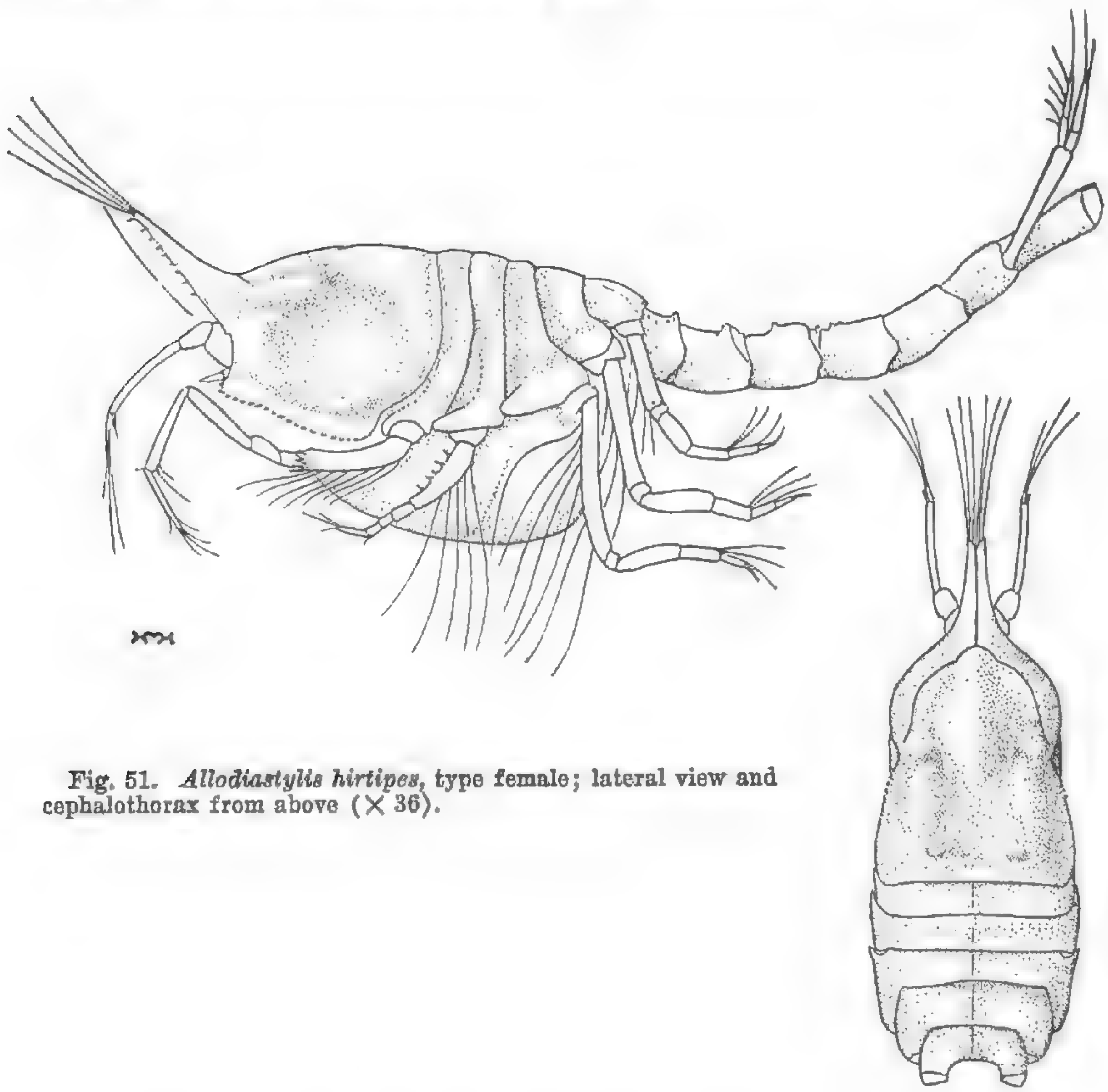

Fig. 51. *Allodiastylis hirtipes*, type female; lateral view and cephalothorax from above (× 36).

Second peraeopod short (not much more than one-third as long as first) with the narrow basis equal in length to rest of limb and spinose on inner margin; ischium suppressed; merus longer than carpus or propodus, which are subequal in length, each barely more than half as long as dactylus.

Basis of third peraeopod as long as remaining joints combined, that of fourth distinctly shorter, in third half as long; merus of third and fourth pairs about as long as carpus and propodus combined; carpus with two distal setae, subequal in length and, like propodal seta, reaching a little beyond level of tip of dactylus, which is long and slender.

Peduncle of uropod narrow, a little longer than telson and two-thirds as long again as rami, which are equal in length; first of the two segments of endopod with two inner setae and three-fourths as long as second joint, which bears three long inner setae and a slender terminal spine almost as long as ramus; exopod with a few short spines on outer margin and two unequal slender distal spines, one of which is fully as long as the ramus.

Colour creamy with the faintly pearly appearance noted in all species of the genus. Length 3·15 mm.

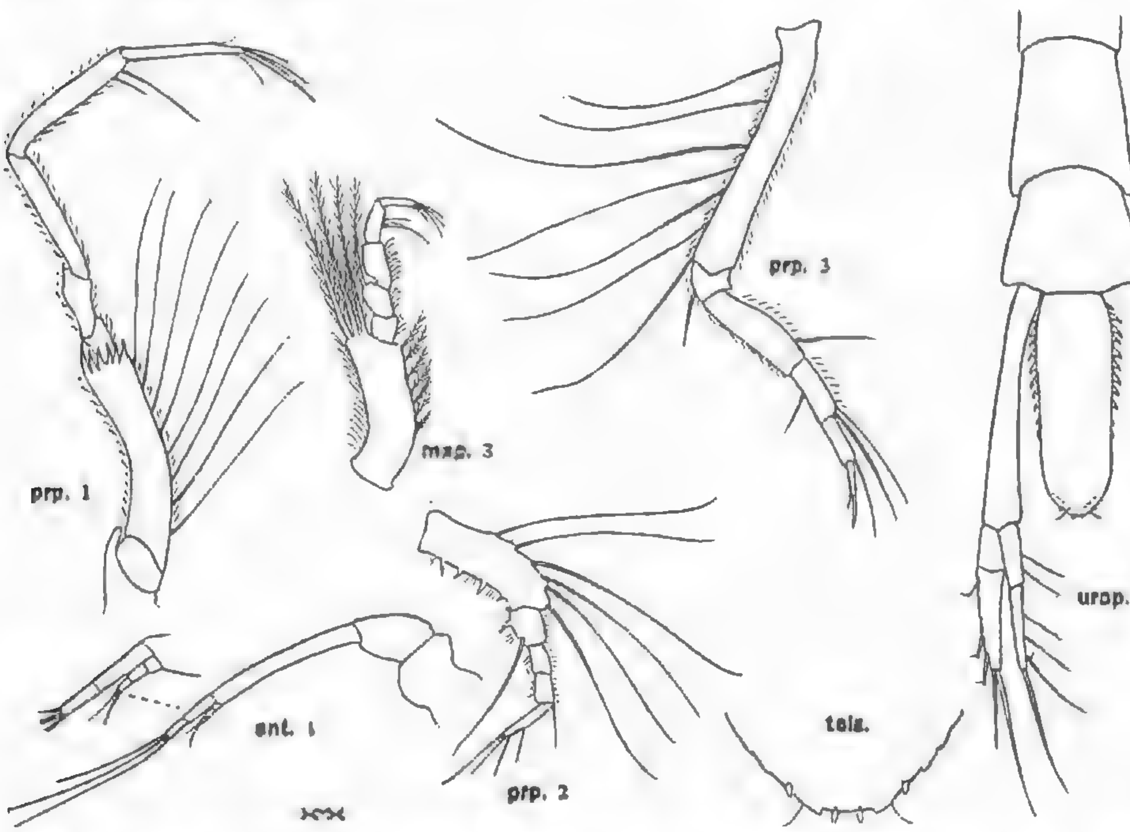

Fig. 52. *Allodiastylis hirtipes*, paratype ovigerous female; ant., first antenna (× 80; flagella, × 125); mxp. and prp., third maxilliped and first to third peraeopods (× 80); urop., uropod with fifth and sixth pleon somites, and telson (× 80); tels., distal end of telson (× 320).

Loc. New South Wales: 4 miles off Eden, 70 metres, in silt (type loc., K. Sheard, Oct., 1943); 4 miles off Port Hacking, 80 metres, on mud (K. Sheard, A. Trawl, May, 1944); Ulladulla, Brush Island, 45 fath., in fine silt on flathead grounds (D. Rochford, Jan., 1945). Type female in South Australian Museum, Reg. No. C. 2719.

The slender respiratory siphons lie for the greater part of their length beneath the pseudorostrum. Probably the long setae of the peraeopods are plumose but with the lateral elements so fine as to escape detection in the fouled condition which remains even after cleaning. Some examples have the granulation of the carapace a little more pronounced than in others; juveniles have the posterior peraeopods shorter and stouter than in the adult.

Off Brush Island this species was taken in company with *tenuipes* but is at once separated by the more slender pseudorostrum and pleon, the less slender posterior peraeopods with longer fringing hairs, and above all by the less dilated first and second joints of the peduncle of the first antenna and the very different proportions of the uropod.

ALLODIASTYLIS JOHNSTONI sp. nov.

Ovigerous female. Carapace as described for *cretata*, to which the species is closely allied; it is fully one-third of total length of animal and much longer than pedigerous somites together. Rostral siphons very long and wide.

Pedigerous somites not differing markedly in dorsal length, but successively becoming longer; second with pleural parts a little expanded forwards; third expanded fore and aft on sides, but second and third legs separated by a space no greater than that between third and fourth.

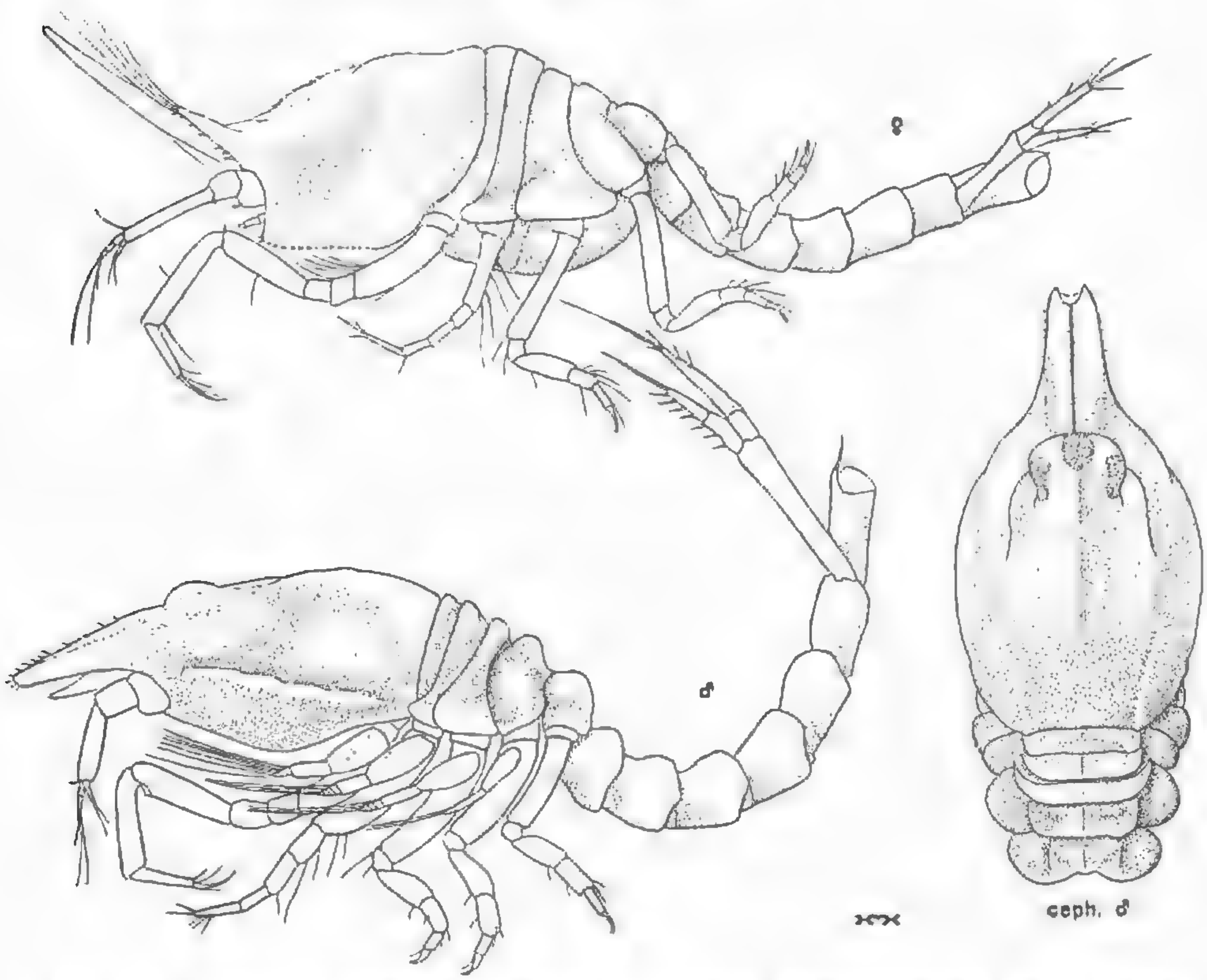

Fig. 53. *Allodiastylis johnstoni*, types female and male; lateral views and (ceph.) cephalothorax from above (× 42).

Pleon cylindrical, the first to sixth somites not differing much in length, the fifth little longer than sixth, which is broadest in distal half, where it is half as wide again as long; telson cylindrical, with distal part suddenly tapering to the narrowly rounded apex which has a pair of rudimentary spines; it is nearly twice as long as the sixth pleon somite.

First antenna much as in genotype, with a distal spine below first two joints, which together are only about two-thirds as long as the elongate third segment; flagellum three-jointed, one-third the length of last peduncular joint; accessory lash also three-jointed, fully half as long as main flagellum.

Basis of third maxilliped short, broad distally, where the external part is forwardly produced; it is shorter than the first four joints of the palp and its

internal apical angle is spinose; remaining joints as in *tenuipes;* ischium and merus each with a small inner spine.

Basis in all peraeopods with a few long setae. First leg stout, when extended with carpus reaching well beyond antennal angle, and propodus past apex of pseudorostrum; basis short, barely more than one-fourth of length of rest of limb, with a few spines on distal margin; carpus and propodus subequal in length, each almost half as long again as dactylus.

Second peraeopod nearly half as long as first; basis three-fifths as long as rest of limb; ischium suppressed; carpus barely longer than merus but distinctly longer than propodus, which is two-thirds as long as dactylus.

Basis of third peraeopod slightly longer than remainder of limb, that of fourth barely shorter; merus of third and fourth pairs about as long as carpus and propodus together; propodal seta and longest carpal seta not reaching beyond tip of dactylus, which is not markedly elongate.

Peduncle of uropod dilated distally, not quite as long as telson and as long as exopod, which is one-fourth as long again as endopod; longest terminal spine of exopod slender, a little shorter than the ramus; endopod with first joint slightly longer than second and with long terminal spine distinctly less than length of ramus.

Length 2·17 mm.

Adult male. Integument translucent, crisp but not highly calcified; surface of carapace with coarse reticulate patterning which is seen with difficulty because of the transparency.

Carapace large, about two-fifths of total length of animal, depressed, fully one-third as wide again as greatest depth; on each side there is a marked dorso-lateral swelling in anterior half, below which the sides are concave; at the rear of this lateral hollow the hinder parts of the sides are tumid and below it is a greatly elevated fold; on the dorsum there is a sharp, median longitudinal carina running from ocular lobe to about three-fourths of length of carapace; the back is depressed on each side of this ridge, but rounded at the rear, where there is a pair of low dorso-lateral carinae; finally, there is a similar pair of ill-defined dorsal ridges on each pseudorostral lobe. Antero-lateral angle narrowly rounded, not serrate. Pseudorostrum long, blunt and downbent, the lobes meeting for a distance equal to one-third of length of carapace; it bears short hairs (in no way like those of the female and young male) and is feebly serrate below. Frontal lobe distinctly delineated; ocular lobe tumid, very large, twice as wide as long and much bigger than in female with three larger eyes exhibiting a granular structure.

Pedigerous somites together less than half as long as carapace; the first three are crowded so that the anterior angle of pleural parts of second overlap first and even carapace; pleural parts of third to fifth swollen, rounded, those of third moderately expanded fore and aft; the back of each somite is elevated, the tumidity bounded by a longitudinal carina on each side in fourth and fifth somites.

Pleon much shorter than cephalothorax, stouter than in female, but with sixth somite not much broader than long and not shorter than fifth; telson stouter than in female, less than half as long again as sixth somite, with the pair of slender terminal spines more than one-fourth of length of telson.

First antenna with peduncular joints less unequal in depth than in female; the stout third segment is as long as first two together; flagella subequal in length, each three-jointed (see fig. 54) and more than one-third as long as last segment of peduncle.

Second antenna richly furnished with fine setae; the flagellum consists of eleven short and stout segments, the proximal four not longer than wide: the lash is not as long as peduncle.

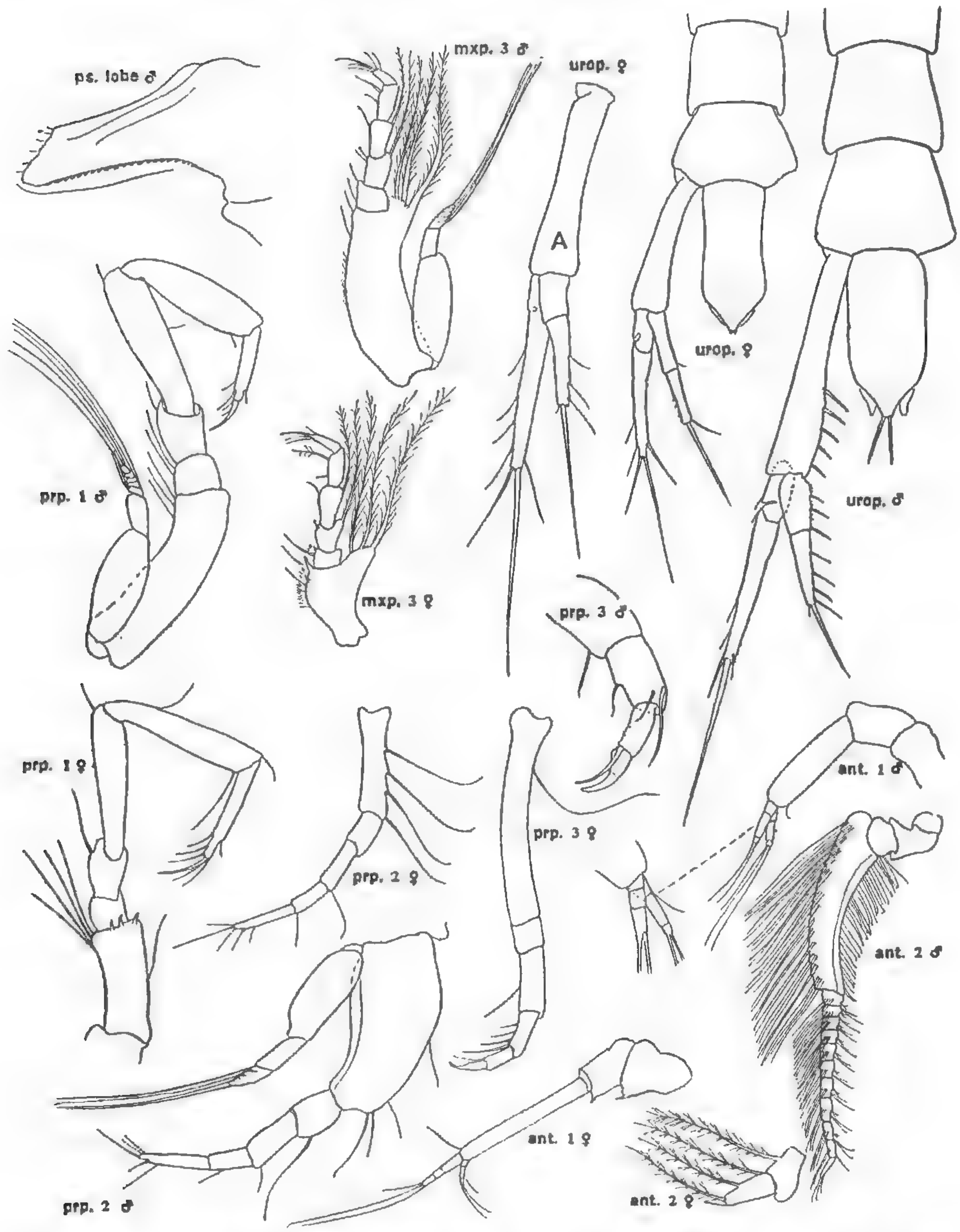

Fig. 54. *Allodiastylis johnstoni*, paratype ovigerous female and type male; ps. lobe, pseudorostral lobe (× 75); ant., first and second antenna (× 75; second antenna of female, × 120); mxp. and prp., third maxilliped and first to third peraeopods (× 75; distal joints of fourth leg of male, × 120); urop., uropod with fifth and sixth pleon somites, and telson (× 75). A, Uropod of *A. cretata* for comparison (× 75).

Third maxilliped with basis much larger than in female, longer than the palp; merus, carpus and propodus subequal in length, each longer than ischium or dactylus.

All peraeopods stouter than in female. First peraeopod broad, with basis half the length of combined remaining joints, which are of same proportions as in female; exopod stout, longer than basis.

Second peraeopod more than half as long as first, with basis almost as long as rest of limb; ischium suppressed; remaining joints about same proportions as in female.

Third to fifth peraeopods with distal carpal setae shorter than in female, but propodal seta reaching to tip of dactylus.

Peduncle of uropod one-third as long again as telson, dilated in distal half, where the inner margin bears five spines; exopod shorter than peduncle and with the main terminal spine stout and not quite as long as the ramus; endopod about two-thirds as long as exopod, and with first joint a little shorter than second; the proximal segment has three inner spines, the distal four and a stout terminal spine little longer than the joint itself.

Length 2·66 mm.

Loc. New South Wales: Sydney Harbour, Vaucluse, stones on reef (type loc., Prof. T. Harvey Johnston, Jan., 1937) and Shark Island, stones on reef (K. Sheard, Feb., 1938). Types in South Australian Museum, Reg. No. C. 2153.

An adult male only 2 mm. in length, from Shark Island, differs in some small details from the type; the peduncle of the uropod has six inner spines and the first segment of the endopod seven, while the setae of the fossorial limbs are relatively a trifle longer.

A. johnstoni perhaps should be regarded as a subspecies of the southern genotype, with which New South Wales examples were formerly placed (Hale, 1937, p. 73). As, however, specimens from the two localities differ consistently, a designation is necessary. *A. johnstoni*, like *cretata*, occurs on shore-line reefs, but the female of the last-named species has the peduncle of the uropod longer than the telson, the endopod of that appendage with the proximal segment less than two-thirds as long as the distal, while the terminal spines of both rami are longer (fig. 54, A.). Further, the propodus of the second leg is shorter, less than half as long as dactylus and not much more than half as long as carpus.

The male of *johnstoni* differs little from that of *cretata*, although in the last-named the propodus of the second leg, as in the females of the two forms, is relatively shorter, while the uropod has the terminal spine of the exopod and the first joint of the endopod both relatively shorter.

ALLODIASTYLIS TENUIPES sp. nov.

Ovigerous female. Integument rather coarsely granulate, the granules most distinct on carapace; on first two pleon somites the dorsum is spinose.

Carapace less than one-third of total length of animal, wider than deep and only one-third as long again as broad; dorso-lateral fold represented by an elongate swollen area below frontal lobe; dorsum medianly slightly elevated on, and a little beyond, frontal lobe, posterior to this concave, the slight hollow bounded laterally by low folds; to the rear of and below dorso-lateral fold the sides are depressed. Antero-lateral margin very shallowly concave; antero-lateral angle subacute, dentate, the serrations continuing along lower margin of carapace. Pseudorostrum feebly dentate below, not quite as slender as in genotype, the lobes meeting for a distance not exceeding one-fourth of length of carapace. Frontal lobe broad and ocular lobe short, almost three times as broad as long, without apparent lenses.

Pedigerous somites together about three-fourths as long as carapace, not differing markedly in length dorsally; first to third with pleural parts forwardly produced; the third is bent backwards on the sides also, so that the second and third legs are more widely separated than are the others.

Pleon rather robust, shorter than cephalothorax; fifth somite not longer than sixth, which is widened posteriorly, where it is slightly broader than long; telson stout, one-fourth longer than sixth somite, laterally serrate near base, and with a pair of rudimentary terminal spines.

First antenna with first and second segments of peduncle dilated more than in genotype, being considerably raised on the upper face; the first is as deep as it is long and has a large inferior tooth; third joint rather longer than first two

Fig. 55. *Allodiastylis tenuipes*, type female; lateral view and cephalothorax from above (× 40).

combined; flagellum more than half as long as third segment of peduncle, two-jointed, with the second segment longer than first; accessory flagellum less than half as long as main lash and three-jointed.

Third maxilliped with basis wide and short, dilated and somewhat forwardly produced distally, and not quite as long as the first four joints of the palp; carpus and propodus subequal in length, each longer than any other of the remaining joints.

Basis in all peraeopods with a few moderately long setae. First leg when extended with carpus falling not far short of level of apex of pseudorostrum; basis only two-fifths as long as rest of limb with a few short spines at distal end; propodus distinctly shorter than carpus and fully twice as long as dactylus.

Second peraeopod slender, more than half as long as first leg, with the basis much shorter than rest of limb and dentate on inner and outer edges; ischium not apparent; merus subequal in length to the narrow carpus, which is barely longer than propodus; dactylus about two-thirds as long again as propodus with one of the distal setae long and slender.

Posterior peraeopods long and slender; basis in third longer than rest of limb, in fourth about equal to it, in fifth about two-thirds as long; merus of third and fourth pairs shorter than carpus and propodus together; carpus with two distal setae, unequal in length, the longer, and most distal, like propodal seta, reaching to apex of the long and slender dactylus.

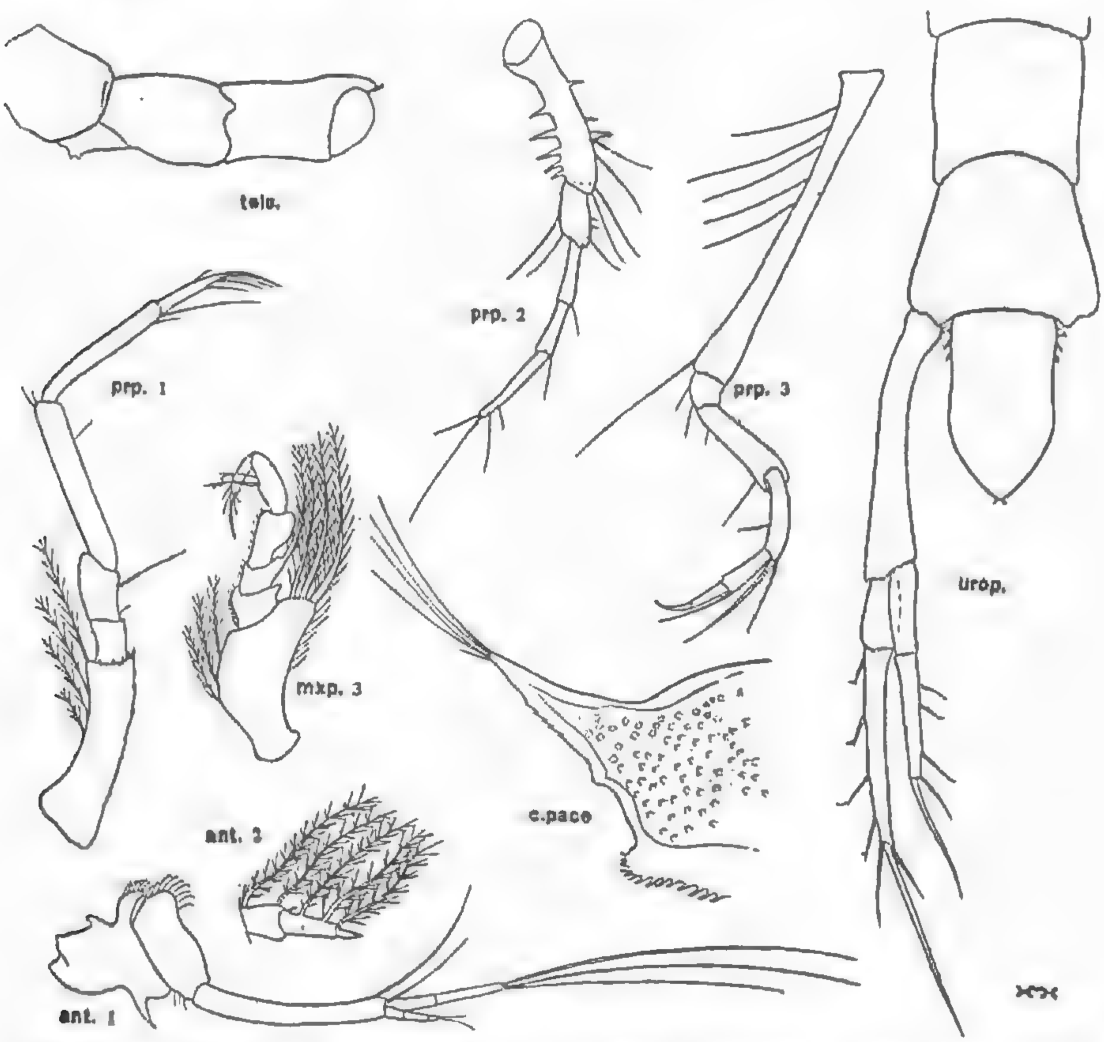

Fig. 56. *Allodiastylis tenuipes,* paratype ovigerous females; c. pace, anterior part of carapace (× 50); ant., first and second antennae; mxp. and prp., third maxilliped and first to third peraeopods; urop., uropod with fifth and sixth pleon somites, and telson; tels., sixth pleon somite and telson from the side (all × 75).

Peduncle of uropod rather narrow, more than one-third as long again as telson and equal in length to the exopod, which is more than one-fourth as long again as endopod; the latter has its first segment barely three-fourths as long as second, which has four inner setae and a slender flexible terminal spine equal in length to itself; exopod with four outer spines on second joint plus three unequal terminal spines, the longest of which is as long as the segment.

Length 2·46 mm.

Loc. New South Wales: Ulladulla, Brush Island, 45 fath., in fine silt on flathead grounds (D. Rochford, Jan., 1945). Type in South Australian Museum, Reg. No. C. 2702.

The respiratory siphons are large. In one example with the first peraeopods asymmetrical the shorter of the pair has the inner margin of basis, ischium and merus spinose.

Genus ZIMMERIANA nov.

Dic Zimmer (*nec* Stebbing) 1914, p. 190; Hale, 1936, p. 422.

This genus shares with *Allodiastylis* a complete absence of thoracic exopods in the female and the development of a pair of long terminal spines on the male telson. Added to these characters the modification of the first peraeopod is distinctive, the dactylus being large and subcylindrical, with an unusual arrangement of the setae, these radiating, mainly from the distal third, to form a brush unlike the dactylar furniture occurring elsewhere. As in *Allodiastylis* and *Dicoides*, the basis of the first peraeopod is very short in relation to the rest of the limb.

The pseudorostrum is almost horizontal in the female, decidedly downbent in the adult male; the telson is subcylindrical in both sexes. The second antenna of the male is short, the flagellum not exceeding the peduncle in length, the basis of the third maxilliped is rather strongly widened distally in both sexes and the mandible, as in *Gynodiastylis*, has about ten spines in the row (seven to eleven). The endopod of the uropod is trisegmentate in the female and young male, bisegmentate in the adult male.

Genotype *Dic lasiodactylum* Zimmer.

The genus is named after Dr. Carl Zimmer, who described the type species.

Only one adult male is available; this differs remarkably in form from the female but was associated with it in the first place by the unmistakable structure of the first peraeopod, just as in the related *Allodiastylis* the first antenna provided the key character.

KEY TO SPECIES OF *ZIMMERIANA*

1. Telson longer than peduncle of uropod and armed with spines ventrally .. *spinicauda* (Hale).
   Telson not longer than peduncle of uropod and not spinose ventrally .. .. .. 2.
2. Ovigerous female with pleon longer than cephalothorax and with anterior peraeopods long. Carpus of first pair distinctly longer than basis and carpus of second about twice as long as merus .. .. *longirostris* sp. nov.
   Ovigerous female with pleon not as long as cephalothorax and with anterior peraeopods shorter and stouter; carpus of first pair only about as long as basis, and carpus of second half as long again as merus .. .. *lasiodactyla* (Zimmer)

ZIMMERIANA SPINICAUDA (Hale)

Dic lasiodactylum var. *spinicauda* Hale, 1937, p. 69, fig. 5b (also Hale, 1936, p. 423–424, fig. 13, a–g.).

This form occurs in Spencer and St. Vincent Gulfs, South Australia; the adult male has not been taken yet. Apart from the character of telson and carapace the dactylus of the first peraeopod is relatively longer than in the other species referred to the genus.

ZIMMERIANA LONGIROSTRIS sp. nov.

Dic lasiodactylum Hale (*nec* Zimmer), 1936, p. 422 (part) and 1937, p. 69, fig. 5 a.

Ovigerous female. Integument not highly calcified, tough and not brittle; surface shallowly pitted.

Carapace not quite one-third of total length of animal and twice as long as pedigerous somites together; it is more than half as long again as deep, and as wide as deep; from above it sub-pyriform with pseudorostrum long and slender, on each side there is a slight concavity, margined above and below by a low,

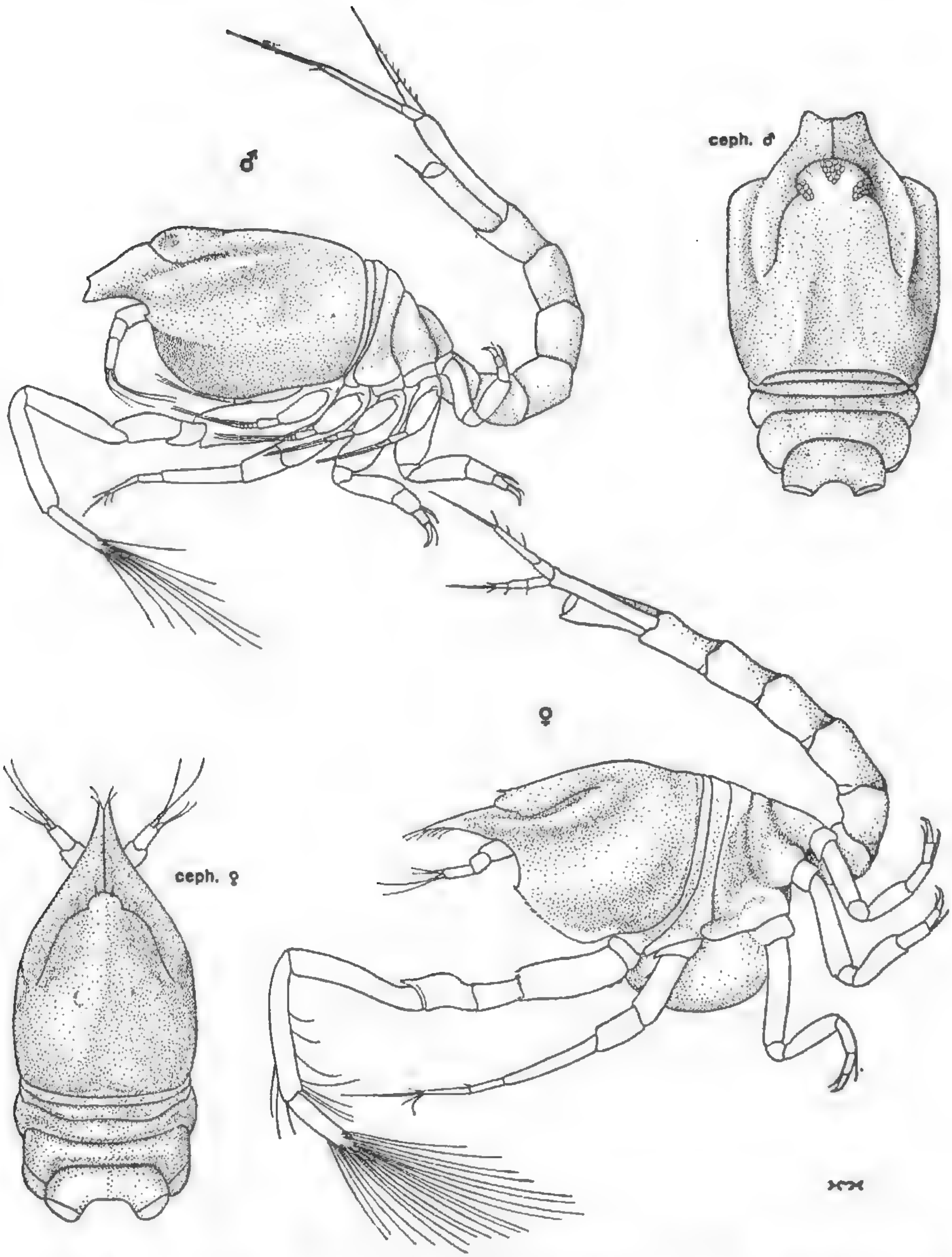

Fig. 57. *Zimmeriana longirostris*, type female and allotype male; lateral views and (ceph.) cephalothorax from above (× 40).

rounded fold; the back is faintly excavate in posterior half and there is a pair of low, rounded elevations at posterior end of frontal lobe, which is indistinctly medianly carinate. Antero-lateral margin shallowly excavate; antero-lateral angle and margin posterior to it finely dentate. Pseudorostral lobes, as seen from above and also in lateral view, subacute in front, meeting for a distance equal to distinctly more than one-fourth of length of carapace. Frontal lobe distinctly marked off; ocular lobe rounded, rather small, wider than long, without apparent lenses and armed with a pair of slender denticles.

First and second pedigerous somites short, third and fourth equal in length dorsally, fifth longer; pleural parts of second expanded forwards, of third forwards and backwards, bringing the second and third peraeopods fairly wide apart; fourth somite fused with third, bent backwards on sides, there being a greater space between coxae of third and fourth legs than between fourth and fifth.

Pleon longer than cephalothorax; sixth somite relatively long, not shorter than fifth, dilated near posterior end, where it is about as broad as long; telson a little longer than sixth somite, cylindrical, with triangular apex armed with a pair of rudimentary spines.

First antenna with first joint of peduncle subequal in length to second and third together; second two-thirds as long as third; flagella two-jointed, the accessory flagellum as long as first joint of main lash (fig. 58, ant.).

Third maxilliped stout, with a strong tooth at distal end of ischium.

First peraeopod very long, the merus reaching level of apex of pseudorostrum; the short basis is only one-fifth of total length of limb and is armed with a few teeth, particularly at distal end; ischium and merus with distal teeth; carpus and propodus subequal in length, each longer than basis, and nearly half as long again as the dactylus, which bears a dense radial brush of setae.

Second peraeopod reaching forward to level of apex of pseudorostrum; basis very short, one-third as long as remaining joints together and much shorter than carpus; ischium obsolete; carpus twice as long as merus and longer than propodus and dactylus together; dactylus about one-third as long again as propodus and with one of the terminal setae robust, almost spine-like, and much longer than dactylus.

Third to fifth peraeopods successively decreasing in length; merus not much longer than carpus and propodus together; carpus with one stout distal seta which does not reach much beyond distal end of propodus, the seta of which is also unusually short.

Uropods slender; peduncle a little longer than telson and nearly twice as long as endopod, which is distinctly shorter than the exopod and consists of three joints, successively decreasing a little in length, and each with an inner seta at distal end; terminal spines a little shorter than their respective rami.

Colour dingy yellow. Length 2·6 mm.

Adult male. Integument transparent, but calcified and brittle. Carapace with coarse, somewhat reticulate, shallow pitting and with the lateral hollow margined above and below by a large fold; the lower fold projects as a prominent ledge, the carapace seen from above being thereby much broadened, and is considerably wider than deep; it is two-thirds as long again as depth, fully one-third of total length of animal and is more than twice as long as the pedigerous somites together; dorsum shallowly excavate. The summit of the lower lateral fold of carapace is elevated to form a narrow ridge, particularly distinct anteriorly, where it curves into the wide and shallow antennal notch, obliterating antennal angle, behind which the inferior margin is almost smooth. Pseudorostrum bent downwards (thus foreshortened in dorsal view of cephalothorax in fig. 57) with anterior

margin subtruncate and sinuate as seen from above and also from side; the lobes meet for a distance equal to almost one-fourth of length of carapace. Frontal lobe large and distinctly defined; ocular lobe rounded, nearly twice as broad as long, with three very large lenses showing granular structure.

Pedigerous somites with pleural parts not so markedly expanded as in female and coxae rather crowded.

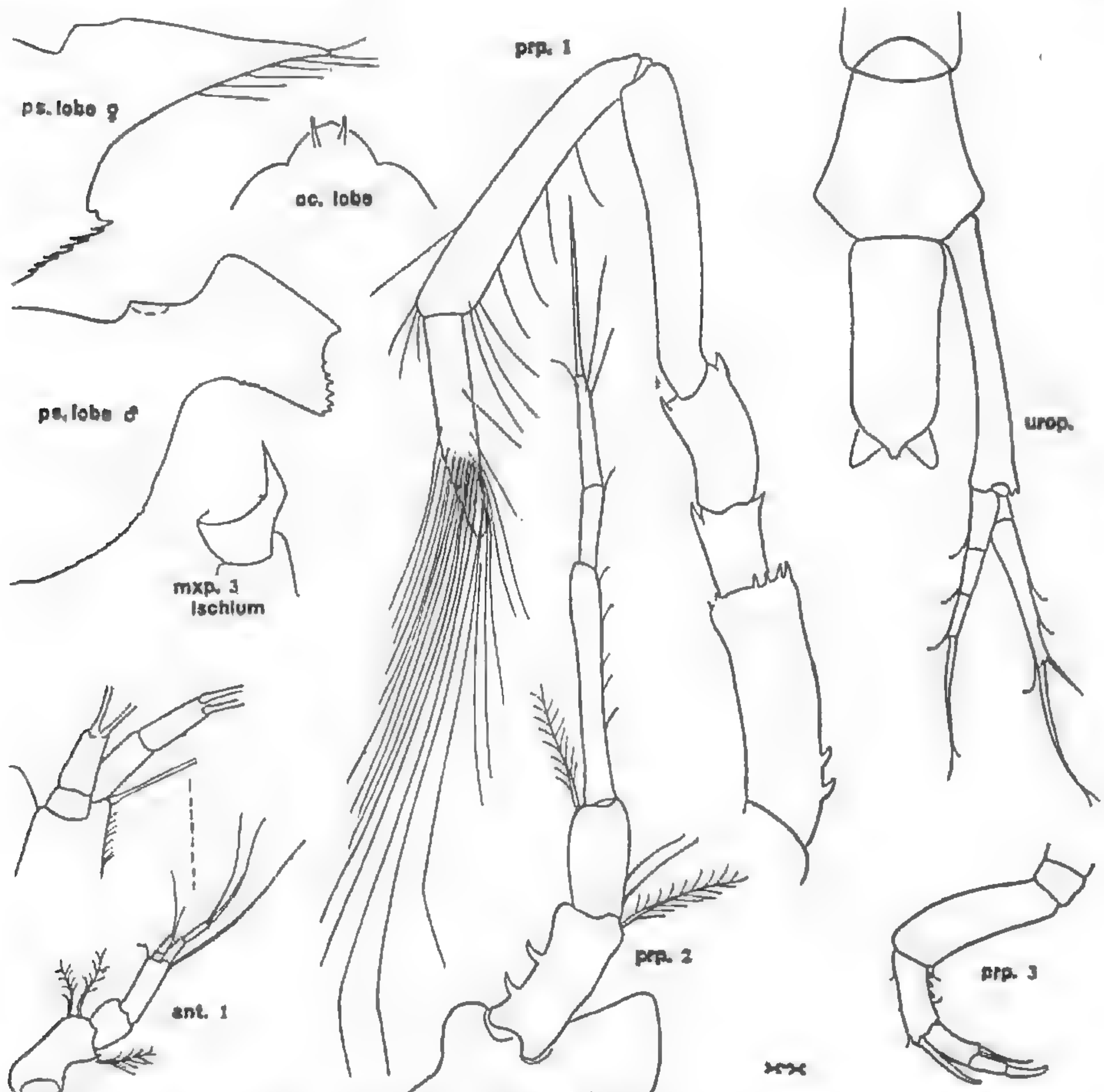

Fig. 58. *Zimmeriana longirostris*, paratype female; oc. lob. and ps. lobe, ocular and pseudorostral lobes (× 75); ant., first antenna (× 75; flagella, × 250); mxp. 3 ischium, ischium of third maxilliped (× 125); prp., first and second peraeopods, and third leg without basis (× 75); urop., uropod with fifth and sixth pleon somites, and telson (× 75). ps. lobe ♂, Pseudorostral lobe of male (× 95).

Pleon as long as cephalothorax; sixth somite slightly less dilated at rear than in female; telson more than one-third longer than sixth somite and with a pair of apical spines (each more than one-fourth as long as the telson) flanked by a pair of short bristles.

Main flagellum of first antenna three-jointed. Second antenna with flagellum eleven-jointed and not longer than peduncle.

Moderately well-developed exopods on third maxilliped and first four pairs of peraeopods. Third maxilliped with spine on ischium.

First peraeopod relatively shorter than in female but with basis longer, about one-fourth of total length of limb and as long as propodus.

Second peraeopod with basis more than half as long as rest of limb and longer than carpus; ischium obliterated; carpus half as long again as merus, and as propodus and dactylus together.

Third to fifth peraeopods with merus and carpus, as well as basis, stouter than in female.

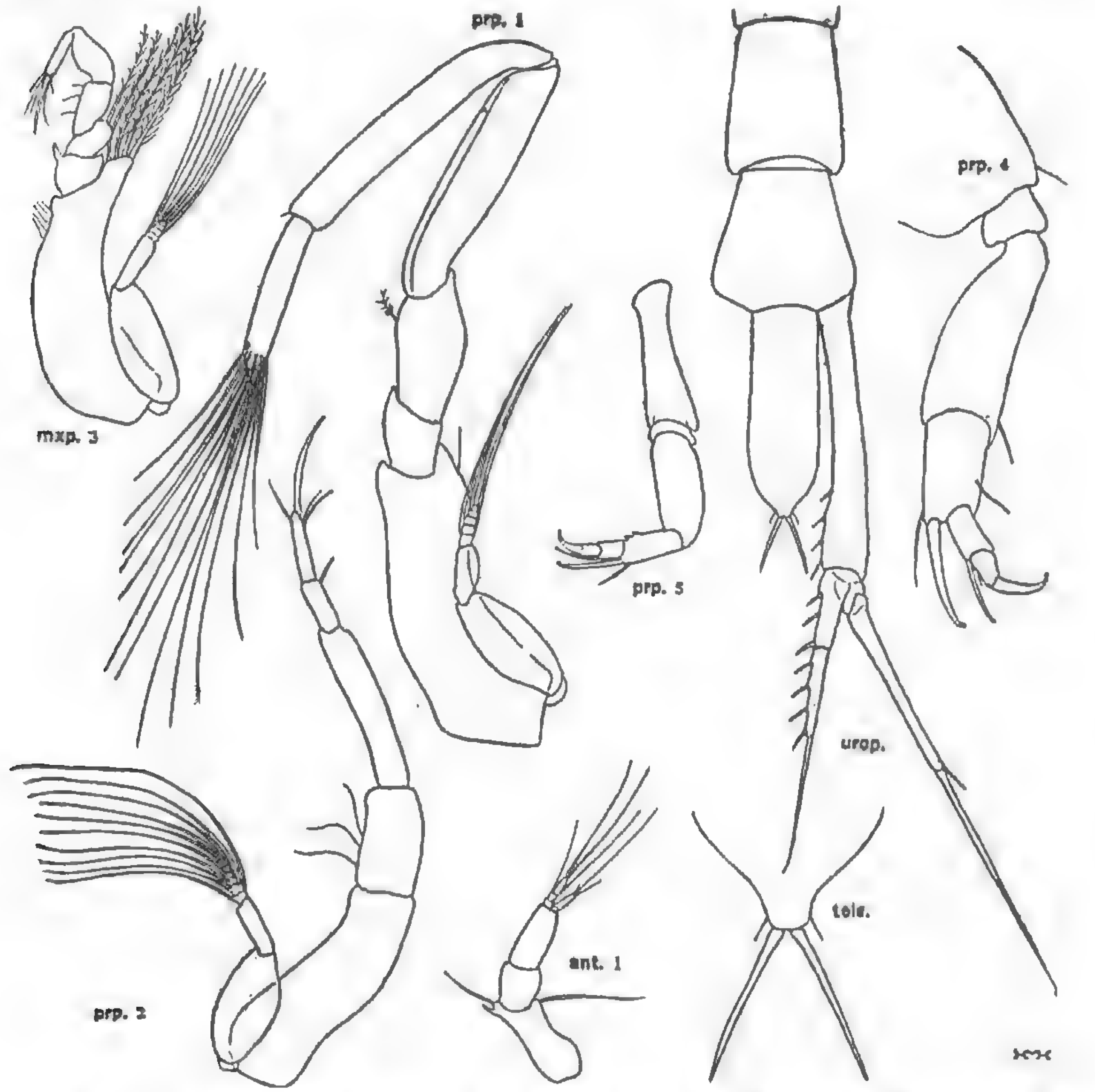

Fig. 59. *Zimmeriana longirostris*, type male; ant. and mxp., first antenna and third maxilliped (× 75); prp. 1, 2 and 5, first, second and fifth peraeopods (× 75); prp. 4, distal joints of fourth peraeopod (× 95); urop., uropod with fifth and sixth pleon somites, and telson (× 75); tels., distal end of telson (× 225).

Peduncle of uropod one-fourth as long again as telson, and with four inner spines in distal third; endopod longer than in female, distinctly more than half length of peduncle and only two-jointed, the first with three inner spines and barely shorter than second, which bears four spines on inner margin and a slender terminal spine not much shorter than the whole ramus; exopod relatively longer and more slender than in female, one-third as long again as endopod with the main terminal spine as long as the ramus.

Length 2·3 mm.

Loc. South Australia: St. Vincent Gulf, Sellick's Reef, on stones, ½–1 fath. (H. M. Hale, Apl., 1936, type female and Mar., 1944); Page Islands, 9 fath. (type male, K. Sheard, submarine light, 7 to 7.30 p.m., Apl., 1941). Types in South Australian Museum, Reg. No. C. 2655 and 2658.

Allowing for the usual differences, the appendages of the male and female described above are so similar that one cannot doubt that they belong to the one species and that, as in *Allodiastylis*, there is considerable sexual dimorphism.

The first legs of the single male were folded together in a manner reminiscent of *Pomacuma*, etc. (Hale, 1944a, p. 234), the propodus bent back against the carpus, while the inner faces of propodi and dactyli were closely approximated, the whole limbs forming a sort of operculum; the distal ends of the carpal joints of these limbs were fitted intimately into the concave front ends of the pseudo-rostral lobes.

The ovigerous female of *longirostris* is very like that of *lasiodactyla*, but Zimmer describes and figures the pseudorostrum as being much shorter in his species, only one-fifth of the total length of carapace, the pleon is shown as shorter than the cephalothorax, while the peraeopods and uropods are stouter (see notes under *lasiodactyla* below).

ZIMMERIANA LASIODACTYLA (Zimmer).

Dic lasiodactylum Zimmer, 1914, p. 193, fig. 17–18; Hale, 1936, p. 422.

The adult female described above as *longirostris* was formerly regarded as representing a variant of this species, with anterior legs longer than in the type and than in some juveniles from Tasmania. Now, however, it is possible

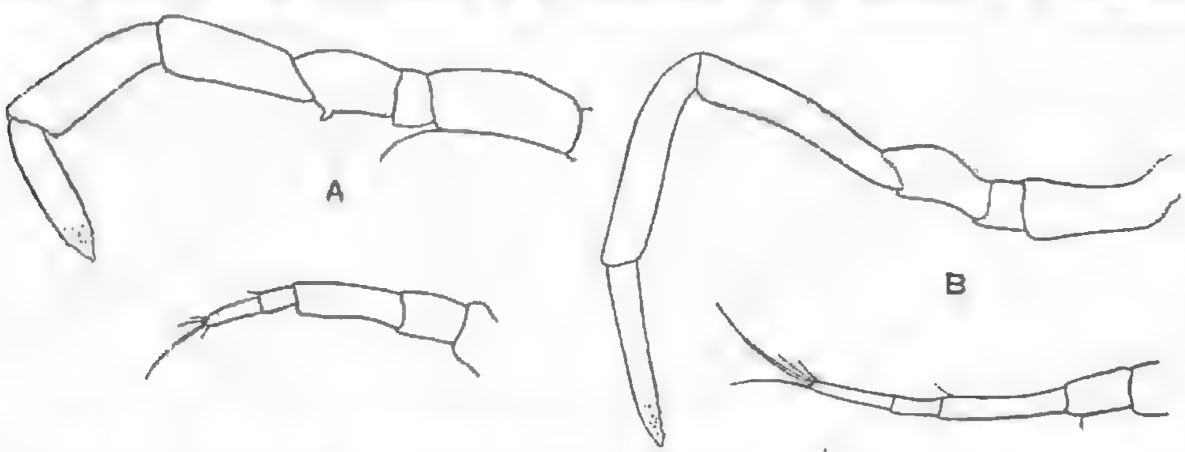

Fig. 60. First and second peraeopods of (A) *Zimmeriana lasiodactyla* and (B) *Z. longirostris*; the long dactylar setae of first peraeopod are omitted (× 70).

to compare a long-legged female (*longirostris*) 1·55 mm. in length with a slightly larger female (1·75 mm.) of *lasiodactyla* from the last-named locality. Although owing to immaturity the proportions of the joints of the limbs are not quite as in the adult the differences are apparent in these examples of approximately the same stage, just as they are in the ovigerous female of *longirostris* and that described by Zimmer for *lasiodactyla*. Thus it seems that the two forms are consistently distinguished, Zimmer's species having the distal joints of the first and second peraeopods shorter and stouter than in *longirostris*, as well as the pseudorostrum, telson and uropods relatively shorter.

As in *longirostris* and *spinicauda* the ocular lobe bears a pair of spines, the only apparent difference from Zimmer's description.

SUMMARY.

Australian Diastylids belonging to *Gynodiastylis* and related genera are dealt with. These are distinguished by the facts that while the third maxilliped of the female lacks an exopod the male has no pleopods. The telson is variable, usually with post-anal part short and sometimes unarmed or almost so; it exhibits sexual difference in two of the genera.

The genera represented are *Sheardia* gen. nov., *Gynodiastylis* Calman, *Dicoides* gen. nov., *Allodiastylis* Hale and *Zimmeriana* gen. nov.

Species described as new are *Sheardia antennata; Gynodiastylis rochfordi, G. lata, G. robusta, G. dilatata, G. strumosa, G. ampla, G. subtilis, G. carinirostris, G. polita, G. ambigua, G. attenuata, G. echinata, G roscida, G. mutabilis. G. ornata, G. margarita, G. quadricristata, G. brevipes* and *G. concava; Dicoides areolata* and *D. fletti; Allodiastylis hirtipes, A. johnstoni* and *A. tenuipes; Zimmeriana longirostris.*

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ABORIGINES OF THE LOWER SOUTH-EAST OF SOUTH AUSTRALIA

BY T. D. CAMPBELL, J. B. CLELAND AND P. S. HOSSFELD

PART I. Millicent-Rendelsham District
PART II. Kongorong District. General Geological Notes
PART III. Review of Food Supplies

Summary

In March of 1944, a visit was made to the Lower South-East of this State to continue and extend the investigation on aboriginal camp sites made previously by H. V. V. Noone and one of the present writers (T.D.C.). An account of these latter observations was published in these Records in 1943.

The present work was planned to amplify previous investigation into more of an ecological approach; that is by corrrelating available recorded information of the once living aboriginal with an intensive study of the present day remnants of his material culture and indigenous environment. By this means we can learn something of his reactions and adjustments to his particular geographical circumstances; and, in short, endeavour to reconstruct a picture of his ways of living. The limited time available was sufficient only for observation on the general features of the camp sites and areas concerned; but some points have been studied in detail and the data, stone implements, and other material collected considerably augment those gathered on the 1943 visit.

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Plate vii, and Text fig. 1–8.

PART I. MILLICENT-RENDELSHAM DISTRICT.

PART II. KONGORONG DISTRICT. GENERAL GEOLOGICAL NOTES.

PART III. REVIEW OF FOOD SUPPLIES.

PART I.

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Plan of present study. In the paper by Campbell and Noone, a description was given of a number of camp sites examined as well as a classification and account of the implements collected, and a few general remarks on topography and the problem of antiquity of aboriginal occupation. In the time available, the present study attempted to amplify, in particular, a consideration of the ecology of the aboriginal of this area in days past. To advance this purpose, a more detailed study was made of the nature and location of the camp sites. The topography of the sites and adjacent areas and associated vegetation were noted in some detail; also sources of implement materials, water and likely food supplies. Surveyed plans were made of some sites; photographs and sketches of special features were secured. Some observations were made on the geology of the region—which necessarily requires protracted study—an interesting problem being the sequence and age of the dune ridges and their relation to the time of human occupation. All geological and physiographical accounts of this territory by previous observers emphasize its importance as an outstanding area for studies in recent geology.

Included in the above outlined general plan of work was the collection of stone implements, botanical and geological specimens.

Area concerned. Some of the camp sites on and near the Woakwine Range examined in 1943 were revisited in 1944, and in addition a number of previously unrecorded sites were made available through the enthusiastic and valuable reconnaisance of Mr. David Schulz of Rendelsham. Those under present review

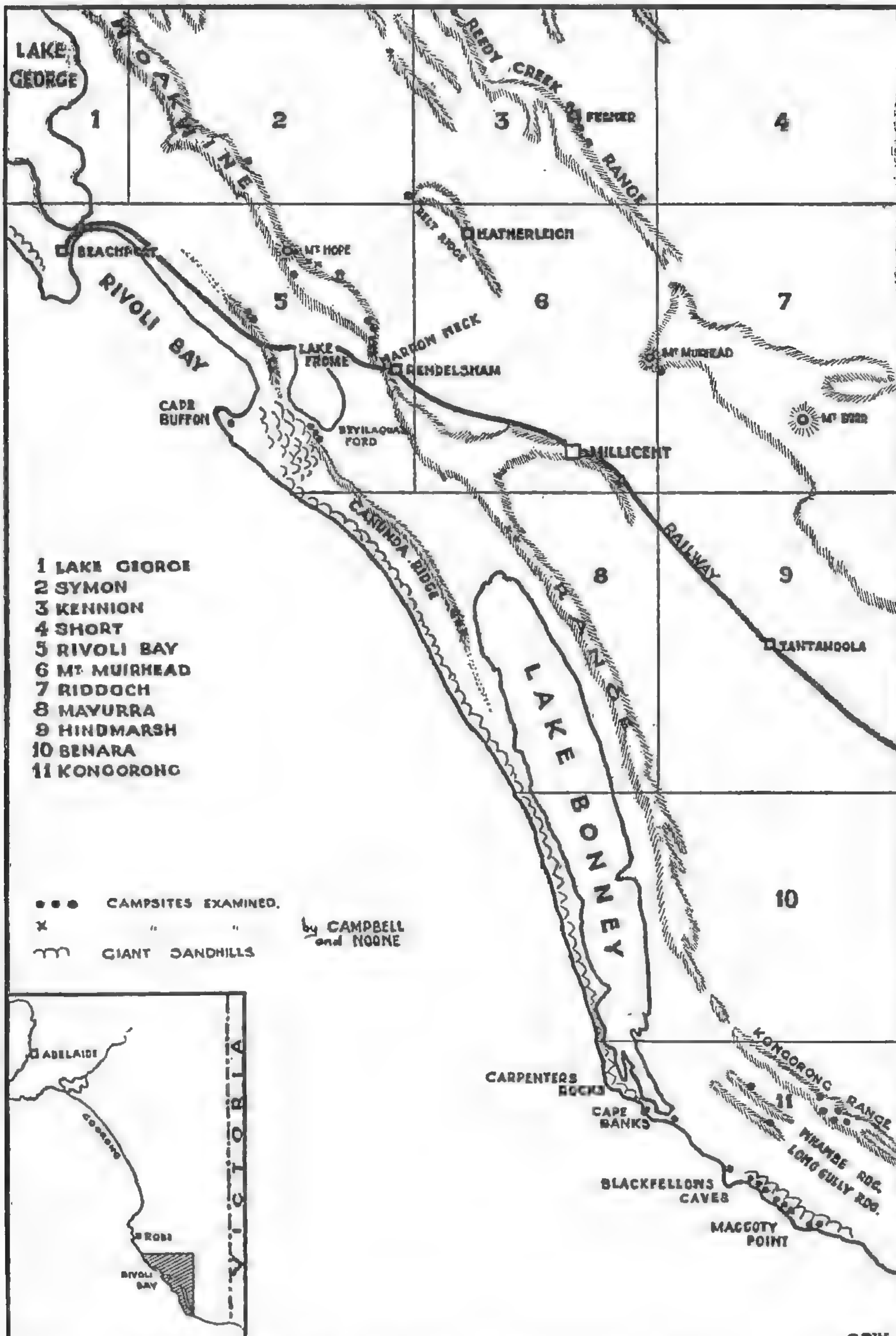

Fig. 1. Map of Lower South-East of South Australia.

occur in the Hundreds of Symon, Kennion, Mayurra, Mount Muirhead, and Rivoli Bay; all in County Grey. Nearly all are readily accessible by main roads, with Millicent as a base. The locations of the sites and of other features of special interest are given in subsequent detailed description. See map, fig. 1.

Aborigines of the region. Little has been recorded of the life of the Buandik tribe which occupied this region and became extinct at the end of last century. Two publications by Campbell (1934, 1939) summarized previous available accounts, and the paper by Campbell and Noone (1943), in addition to dealing mainly with stone implements, discussed some aspects of native life which are further studied in the present work.

It is from these rather scant recorded data, and from our observations on remnants of his daily life and material culture, topographical conditions and indigenous flora—the last fortunately persist to an appreciable extent in much of this region—that we are endeavouring to reconstruct a picture of the life of the aboriginal as it was before white man took possession of his territory.

Physiographical features of the area. The South-East[1], as described by Fenner, constitutes "a natural geographic region" and occupies the southernmost portion of this State—south of a rather arbitrary boundary reaching from Kingston on the coastline to Naracoorte, near the Victorian border, in the east. This area consists of counties Robe and Grey. Publications by Woods, Fenner, Ward, and Crocker provide accounts of the general physiography.

The main topographical features of this area are: The coastline forming its western and southern boundaries; the striking series of ranges or ridges, consisting of stranded sand dunes in various stages of consolidation and lying roughly parallel to the coast; the broad flat inter-ridge valleys; the lake and swamp areas fringing the coastline; and the volcanic range system. As will be shown later, all these important general features and their concomitant details were important to the life of the aboriginal inhabitants of the particular area under review.

From various accounts of the district as it was in the early and middle parts of last century, and from present-day observation, it is obvious that first and foremost, the region has long been one of assured rainfall. It carried a fairly abundant and varied vegetation—an appreciable representation of which still remains in many places; but most of the broad inter-ridge valleys has been cleared of their typical swamp vegetation and used for agriculture since white settlement and drainage began. Early accounts describe the country as supporting abundant animal life; while the present lakes and persisting swamp areas, in addition to the expanses now systematically drained, indicate the former abundance of aquatic bird life. Finally the nearby ocean and the permanent lakes were ready sources of fish and shellfish foods.

All these points suggest that the district might have supported a relatively large and stable aboriginal population in an environment which was varied in topography, well served with food and water supplies and other means of living, and had a climate which, though wet and cold in winter, was in general pleasantly temperate. But what actually constitutes a large flourishing population is a problem yet to be studied so far as aborigines are concerned. Arising from these investigations, we hope to give in a later publication an attempt at estimating intensity of aboriginal population on the basis of numbers of individuals per hundred square miles of territory.

It is comparatively easy to-day to go over this country and describe its topo-

[1] The term "South East" is unfortunately used with wide geographical variation. It is suggested that for the area here concerned, "Lower South East" has a more precise meaning. The term Upper South East could then be used for the area between the abovementioned Counties and the River Murray.

graphy and vegetation. But in settled areas many changes have taken place since the time when it was in full occupation by the aborigines a hundred years ago. However, it is fortunate for these studies that much of the coastal strip between the Woakwine Range and the sea coast has remained unsuitable for civilized occupation and usage; and on that account it has retained most of its indigenous topography and much of its native vegetation in a condition which must be similar to that when the aborigines were in possession.

The following extracts from Volume I of "Savage life and scenes in Australia and New Zealand" by G. F. Angas describe the country between Kingston and the Kongorong region as he saw it in 1844 when Governor Grey made an overland visit to what is now known as the Lower South-East. This account gives some vivid pictures, not only of the country itself, but also of aboriginal life encountered during the trip.

Accompanying Governor Sir George Grey were Mr. Burr, the Deputy Surveyor-General, Mr. Bonney, the overland traveller, Mr. Gisbone, George French Angas, and mounted police, servants, bullock drivers and two men belonging to the detachment of sappers and miners, in all eighteen persons.

(Near Kingston, I, p. 149). "Amongst the she-oak trees, we surprised an encampment of native women, who flew off in the greatest terror and consternation, making a loud chattering noise, and leaving their digging-sticks and baskets behind them in their hurry. A curl of smoke from their little fire betrayed the spot they had so lately occupied, and we amused ourselves by examining their utensils and domestic arrangements .... baskets: these were of beautiful workmanship and somewhat resembled those of the Tattayarra natives."

(Between Kingston and Mt. Benson, p. 149). "Beyond Lacepede Bay, we found good cattle country, consisting of grassy flats scattered over with bansksia or honeysuckle trees. During the day we passed through a forest, in which were many trees of stringy-bark and blackwood. In some places the underwood was dense, but as the country began to rise, it became more open, and again descended into banksia flats. On these plains we met with many tracks of natives, and their old encampments were numerous. Heaps of the melliferous cones of the banksia were lying round these deserted wirlies. The natives steep the cones in water, which extracts the honey, and produces a sweet beverage."

(p. 150) " ... Mount Benson—a round-topped eminence, about seven hundred feet above the sea, and the highest of a range of limestone hills. ... We ascended the ridges, which were thickly clothed with banksia and she-oak .... The white and rugged limestone of the range was intersected in every direction with wombat holes that perforated the rock like a honeycomb."

(N.W. end of Woakwine. Mount Benson, p. 150). "We collected together a quantity of dry wood and made a signal fire that must have been visible for many miles. It was soon responded to by the natives towards the south and east, many columns of smoke rising in that direction; and before we descended the hill, the natives were signalizing all around, giving indications of a larger population amongst these banksia woods than we anticipated."

(Traversing East side of Woakwine, p. 150). "Upon the plains beyond Mt. Benson, and those around Lake Hawden, until we reached the neighbourhood of Rivoli Bay, our attention was arrested by the flats being covered in many places with a limestone tufa, in shape and appearance exactly resembling biscuits."

(Still on East side of Woakwine, p. 151). "We reached Lake Hawden—a flat, swampy plain, which, in the rain season, is covered with water. There is good pasturage in the surrounding country, which rises into gently undulating hills lightly wooded with she-oak."

(April 29, p. 151). They fell in with Scott's party, whose "sheep were folded in two large stockyards, which they had erected of boughs, and their horses were tethered near their encampment. This was rudely constructed of reeds, and not nearly so snug as the huts of the natives. . . ."

(April 30, p. 152). ". . . . we travelled onwards across a succession of soft, spongy swamps, the ground being full of holes, and completely undermined by the rats. The sheep stuck in the holes, and could scarcely proceed for the long grass, which caused us considerable delay. Tufts of a gigantic species of plume grass (*Gahnia psittacorum*), with sharp-edged leaves, grew in vast quantities upon several of the flats, and others were scattered over with heaps of dead shells of a reverse *bullimus;* occasional swamp parrots fluttered up from the grass, and a few striped wallaby were met with during the day."

(p. 153). ". . . . we were in the midst of dense thickets which merged into a low scrubby forest of stringy bark, without any distinguishing objects of any kind."

(Probably traversing the Woakwine, p. 153). Cooey-ing to a lost bullock driver. ". . . . The voices of the natives uttering their loud shrill *cooey* echoed along the undulating and wooded ground, rising on each side of a vast swampy plain which we had traversed for several miles. . . ."

(On to W. side of Woakwine, flats between Woakwine and Lake George, p. 155). (May 2). "We penetrated thick woods, among which the elegant *corea*, then in blossom, attained a considerable height; and we crossed more spongy plains, covered with shells and tufa "biscuits" and subject to occasional inundations. Low wooded ranges skirted these plains, and kangaroos were abundant. Some of these swamps were covered with an exceedingly rich black soil, and produced luxuriant sow-thistles and other rank vegetation; the more solid plains were overspread with beautiful green feed, and it was evident we were once more approaching a good country."

(p. 156). "We came so suddenly upon a native encampment amongst the trees, that the savages had barely time to take alarm at our horses' hoofs, and we could just distinguish their heels as they scampered away beneath the bushes. . . . The party we had thus unceremoniously disturbed had evidently assembled to a convivial dinner, for there were two large wombats roasting in in the ovens, several choice heaps of roots lay amongst the ashes, and a fine parrot, not yet cooked, was suspended to a stick. In their precipitate flight they had left all their things behind them—spears, baskets, snaring rods, and a variety of curious implements; these we examined and left precisely as we found them. . . ."

(Opposite Rivoli Bay, p. 156). "We found an extensive swamp intervening between us and the shores of the bay and as we progressed it became more difficult to cross, being covered with sharp dense reeds and tea-tree bushes. . . ."

(Rivoli Bay, p. 157). (May 3). "Long before sunrise we were moving to travel across on foot to Rivoli Bay . . . . we had to brush through grass and matted reeds breast-high. On a grassy knoll, surrounded by she-oaks, we met

with a mound of limestones, like a cairn, which we conjectured to have been placed there by the natives above the bodies of their dead, to protect them from the wild dogs. After a tedious march of six or seven miles through swamps and forests of she-oaks, we gained the sandhills of the seashore. . . ."

(S.E. corner of Rivoli Bay, west of Rendlesham, p. 162). (May 4). "Started at daybreak for Mount Gambier. . . . We travelled along between parallel ridges of sandhills scattered with she-oaks, forming beautiful vistas covered with grass. As we progressed the sandhills grew larger, becoming mountains in aspect; and amidst their intervening dells beautiful magic scenes presented themselves, displaying scenery of a character quite different from anything I ever before witnessed. From the summit of these sandhills we overlooked Rivoli Bay, with the rocky point of Cape Buffon at its southern extremity. Around several native wells we saw lying quantities of limpets and large haliotis shells; which latter the natives use for carrying water."

(On to Woakwine, near Mayurra, p. 162). "Leaving the sandhills, we skirted the shores of a considerable lake, which we called Lake Frome, in compliment to the Surveyor-General. We afterwards crossed more swamps and flats (*"Lake" Canunda*) and again met with the biscuit tufa. Mt. Muirhead and the Bluff bore south-east of us; and, on ascending a wooded range, we discovered the peak of Mt. Gambier [is this possible from here?], distant about forty miles, with several large lakes to the south-west." [Lake Bonney].

(Flats S.E. of Millicent, east side of Woakwine Range, p. 162). "We were now in a beautiful and verdant country, where fine young grass was springing after the late rains."

In addition to the above notes from Angas, the following extracts from Ward and Proud provide further interesting observations on this country as it was over sixty years ago. Ward:

(p.47). Re east side of Woakwine. "The country, whatever its value might otherwise have been, presented only a dreary waste of water for some months of the year . . . . "

(p. 55). "As long as those rich black flats were flooded long enough in the year to keep surveyors and buyers at a respectful distance, all was well. There was plenty of grass on the ridges in winter, and on the flats in summer, and water always."

(p. 58). "On the hollows where water has stood permanently vegetation has been coarse, consisting almost entirely of rushes and reeds, the cattle have been unable to do more than pick over the tops when green. There has thus been in such places a vast deposit of decaying vegetation accumulating year by year. . . . The roots of the rushes alone constitute a large proportion of the deposit. . . ."

(p. 59). "In fact, on all the swamp bottoms, as distinguished from the flats, even where the water has been got rid of, cultivtion will be impossible for the present. Ultimately they will become the richest spots, and in the meantime they will afford rare grazing areas, as finer grasses replace the coarse vegetation they have hitherto borne.

(*Cootel Swamp* at Narrow Neck, p. 59). " . . . . there is a depth of 10 or 11 feet of vegetable deposit before you reach the calcareous bottom, and there, too,

overlying that, is a bed of seaweed still undecayed, but perfectly purged of the saline character it must have possessed before it was wrested from the ocean by the upheaval of the Woakwine range.... The nearest approach elsewhere to this prolific deposit is found invariably on the western sides of the flats just under the ridges where the water has lain longer."

(p. 61). "It may be said to be the prevailing feature of the flats that wherever they exceed one or two miles in width between the ridges they are thickly studded with 'islands', as I may call them, varying from one or two to one or two hundred acres in extent. These islands are of precisely the same character as the adjacent ridges, except, perhaps, that their elevation is not always so great. But they have the same description of soil—a light red loam, intermixed with shell sandstone or limestone—and the same varieties of timber—chiefly she-oak and honeysuckle—as are found on the ridges. There are also gums and blackwood scattered about, so that the stone for building, and wood for either building, fencing, or domestic purposes can be easily obtained...."

(p. 61). " .... So long as the flats were subject to yearly inundation, and consequently valueless to the farmer, the narrow ridges intersecting them, in themselves too stony to be ploughed, could only possess a nominal because uncontested value to the State, derived of course from the graziers who monopolized them...."

(Re Mt. Muirhead, p. 67). " .... It is quite destitute of timber, and being of a considerable height forms a conspicuous landmark from all parts of the flat to the coast; its plain, but verdant surface, presenting a strong contrast to the dismal hues of the scrubby timber at its foot...."

(Mt. Graham, p. 68). "It presents on its summit and slopes a considerable area of good lightly timbered soil.... Residence and head station stand at a good elevation on its northern side, overlooking a wide extent of wet but wooded country, called of course the Mt. Graham Flats, extending to the Avenue Flat on the north and towards Penola on the north-east."

(p. 69). "From Mt. Graham towards Mt. Gambier the course lies along the foot of a stringy bark range to Mt. Burr, another prominent landmark, on which also a trig station is established."

Proud (1880) in a publication by the *Register* on the South-East gives the following account of the vegetation: " .... between Robe and Avenue Railway Station country varies considerably in quality, as nearly all long stretches of land in the S.E. do .... grazing country; with stony ridges, covered with she-oak and light timber. Then there are swampy flats with swamp grass growing upon them, and clumps of a stunted stringy bark are seen further on."

FOOD SOURCES OF THE ABORIGINES.

One of the main parts of these studies was to ascertain from recorded information and observations made during our visits what were the likely foods and food sources of the aborigines in the past. As indicated in previous remarks, the advantages of the district were many and varied, and in Part III of this paper a detailed account has been compiled by one of us (J. B. C.) of the possible and likely food supplies of the natives.

Water Supplies. Owing to a generous rainfall—average 29·5 in. per year—and lack of natural surface drainage, this territory was heavily watered, and

in days prior to the artificial drainage system fresh water supplies must have been available almost everywhere at all times of the year.

On the coastal strip, Lakes Bonney and Frome are permanent waters—the former a sheet of impressive dimensions (about eighteen miles in length and two and a half miles in width). Lake Canunda and several depressions associated with the Lake Frome area are seasonally flooded.

On the flats forming the broad level valley between the Woakwine and the Reedy Creek-Mt. Muirhead Ranges much water still collects in the wet season on certain areas, in spite of the drainage system. These flats have been described as a "dreary waste of water" in pre-drainage days, and remained so for months of the year. In certain locations on the west side of this flat valley and hard against the eastern side of the Woakwine Range barrier depressions exist which were almost certainly permanent swamps. These were known as the Woakwine, Cootel, Permatta, Mayurra, Wyrie, Pompoon, and German Creek Swamps—existing now as names only; for since the 1860–70 intensive drainage works they have become highly productive flats. Cootel Swamp, immediately to the east of Narrow Neck gap, was a striking example, well known to have held water to a depth of at least ten feet for most of the year.

Still further east, on the "inland" side of the Millicent–Hatherleigh subsidiary ridge system, are the Millicent–Mt. Muirhead flats which, in former days, abounded with permanent large springs and were flooded in winter.

Thus there is ample evidence to show that fresh water supplies were abundantly available to the original inhabitants of this district.

Angas notes that the natives round Lake Albert and the adjoining Coorong used human skulls as drinking vessels. They fasten a handle of bulrush fibre to them to carry them, and a twist of dry grass is placed in the water to prevent it spilling (p. 68). A girl on the Coorong carried with her her mother's skull from which "she drank her daily draught of water". (p. 136).

HABITATIONS.

From study of the locations, camp sites and our personal observation of living aborigines in other parts, it is obvious that these South-Eastern natives adopted the usual practice of camping preferably on elevated, well-drained, sandy slopes or hollows on the sheltered side of a ridge or range. Under such circumstances, with ample fires, little constructed shelter would be necessary in warm summer months. But the fact—as records show—that these people did construct "wurlies" fairly often, may be accounted for by the fairly protracted inclement weather; and also, that in a favourable environment, there would be a tendency towards settled domestic habits rather than towards a continuous nomadic existence. Their wurlies were of the usual wood framework, well-covered with tree or bush branches and sometimes with skin rugs. Angas records that the brush humpies of the early shepherds in this region were not to be compared with those seen of the aborigines in construction and tidiness. The same writer refers to wurlies built of earth "clods".

All remnants of such structures have, of course, long since disappeared, so that present evidences of occupation gives no clues to constructional details.

DESCRIPTION OF CAMP SITES EXAMINED.

The following account gives detailed locations of the camp sites and a description of their main features. Where the term "implement" is used, it refers to stone implements only. "Hearths" or "hearth remnants" implies the generally

low, rounded mound of baked sand or soil with associated burnt stones; although the latter repeatedly occur widely scattered, or with no sign of a fire mound. (See plate). The terms "sand area" or "blown sand area" are so well-known that further definition seems unnecessary.

Below is given a list of the camp sites recorded for the 1944 visit to this district. The symbol in brackets has been devised for convenience of reference and marking specimens. Sites marked with an asterisk have been described previously by Campbell and Noone (1943); those marked with two asterisks were also described in their paper, but were revisited during the present work. The remainder of the list are new records.

Canunda Ridge is a new name and is here applied to an interesting partly consolidated, but now disintegrating dune ridge lying between the Woakwine Range and the present coastal dunes. It occurs just west of the Lakes Bonney, Canunda, Frome series. This same ridge (then unnamed) was mentioned by Campbell and Noone.

In Part III some notes are given on possibly useful vegetation associated with certain of the campsite areas which were examined in detail.

*Woakwine Range (Wk. 1), S.W. of Millicent.
*Woakwine Range (Wk. 2), S.W. of Millicent.
*Woakwine Range (Wk. 3), Frank's Island.
*Woakwine Range (Wk. 4), east side of range, near Mt. Hope.
Woakwine Range (Wk. 5), about one mile S.E. of Mt. Hope.
Woakwine Range (Wk. 6) Bullock Is., an eastern outlier of the range.
Woakwine Range (Wk. 7), on eastern side of range, about two miles S.E. of Woakwine Station.
Woakwine Range (Wk. 8)
Woakwine Range (Wk. 9) near Narrow Neck Gap on its north side.
Woakwine Range (Wk. 10)
Woakwine Range (Wk. 11) just north of Mt. Pisgah and about one mile from
Woakwine Range (Wk. 12) Narrow Neck.
*Mt. Muirhead (MM), at main road cutting S.E. of the Mount.
**The Belt (Bt.), N.W. extremity of the Belt Ridge, north of Hatherleigh.
Lake Frome (Fr. 1), on coast side of Lake Frome depression and due west of Mt. Hope.
Lake Frome (Fr. 2), south-east of Fr. 1.
Cape Buffon (Bf.), at Cape Buffon, south end of Rivoli Bay.
**Lake Bonney (Cn. 1), Canunda Ridge sandhills; at north-west corner of Lake Bonney.
**Bevilaqua's Ford (Cn. 2), Canunda Ridge sandhills; just west of Bevilaqua's Ford.
Reedy Creek Range (RC. 1) east side of Range, near Gilchrist's Bridge.
Reedy Creek Range (RC. 2), at east side of Furner settlement.
Reedy Creek Range (RC. 3), at north-west corner of Furner.
Nangula (MR. 1), on east side of Millicent Ridge near Nangula.

WK. 5. A small blown-out sandy ridge situated about one mile south-east of Mt. Hope in Block 75, Hundred of Rivoli Bay. Judging by its present condition, it does not appear to have been a camp of much importance, being small in area and in a position exposed to the keen southerly and westerly winds. On its surface lie the scattered remnants of a few hearths. A small collection of varied implements was gathered, including a polished stone axehead found near this site.

WK. 6. Bullock Island is an easterly outlying portion of the Woakwine Range and the site lies in Sect. 6SW, Hundred of Rivoli Bay. It is an extensive

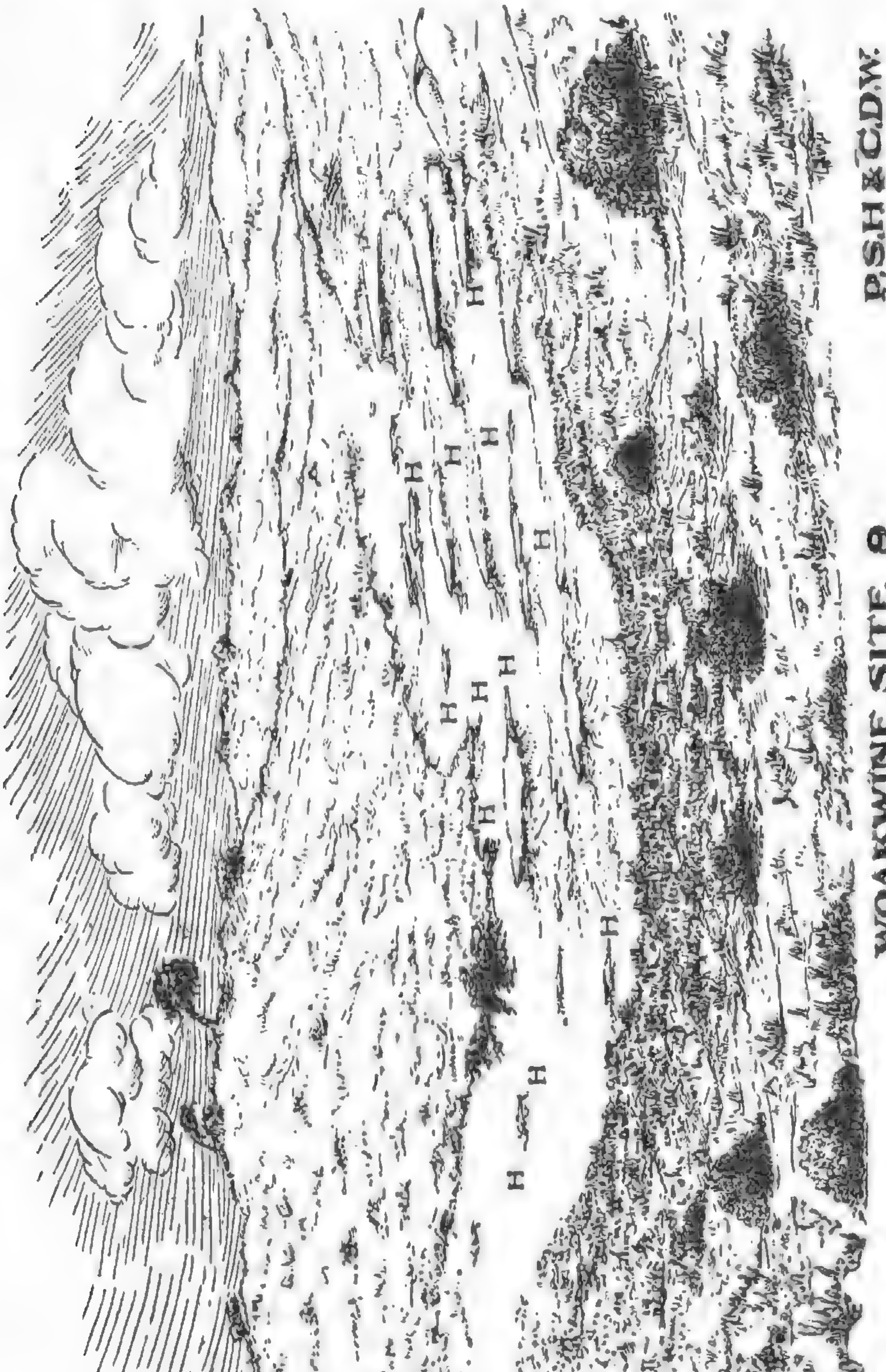

Fig. 2. H, Hearth remnants.

camp area covering probably some fifty acres, and occupies protected and well-drained slopes. Far larger than those sites occurring on the more westerly aspects of the range, it appears likely to have been more of a permanent winter season camp.

A few hearth remnants were noted and a fairly large collection of implements was made in the short time spent in the examination.

WK 7. This site occupies a number of broad, blown-sand areas on the east side of the Woakwine Range and about two miles south-east of the old Woakwine Station. The location probably lies in Section 28, Hundred of Symon. Some portions of this area are on the western faces of the ridges and these were obviously not used so much as the more protected depressions on the eastern slopes. On these latter there occurred some well-preserved hearths; and although implements were not numerous, an interesting collection was gathered, including a polished axehead and a fragment of the same kind of tool.

Water and food supplies in this area (see Part III) were probably ample.

WK. 8, WK. 9, WK. 10. This series of closely associated sites is situated on the Woakwine Range near Narrow Neck Gap on its north side. They lie in Blocks 1 and 2, Hundred of Rivoli Bay.

Considered as a group, these present an interesting feature which may be termed one of "strategic location". Narrow Neck has been a natural gap in the Woakwine Range for a long time—probably dating back to the early history of the range—and was a barrier against any ready passage along this ridge. We have learnt from local information that it was a habit of the aborigines when occupying this particular locality, to organize—no doubt on suitable occasions only—a planned drive of animal life along the range. The women and children would be sent to form a "cordon" stretching right across the range and scare kangaroos and wallabies towards the gap. The menfolk, having previously placed themselves in effective ambush near the gap, would then slaughter the herded, trapped game.

Otherwise these sites present no indications of being impressive locations; for they are rather small areas, in fairly exposed situations. Although like practically all the sites in this region, they were probably well-supplied with water and food supplies, it seems likely they served chiefly the purpose described above. We have learnt lately that the narrow strip of land between Lake George and the sea near Beachport was also used as one of these strategic hunting sites.

Another important feature of Wk. 8 and Wk. 9, particularly the former, and especially in view of the small size of the areas, was the large number of micro implements collected from them. Micro points (Woakwine and Bondi) might be described as plentiful, and it might be suggested that there was some relation between the abundance of these little implements and the matter of animal food supplies. Their purpose may have been either for use on hunting weapons or in the cutting of carcases. The Belt site has some things in common with this particular locality. In Part II the occurrence of these implements and their uses is discussed again.

Beyond a few scattered mollusc shells, no food debris was observed on these three sites.

WK. 8. The most south-easterly of the three is a small, shallow, elliptical, blown area, about 50 yards by 20 yards in dimensions. It was copiously littered with worked stone tools and stone debris; this small area alone provided about 150 microliths. Sparse and scattered remnants of a hearth occurred at each end of the depression which is situated on the slope of a hillside and faces south-east—a rather exposed position. Considering the abundance of small implements on this limited area, it almost deserves to be called "a microlith workshop."

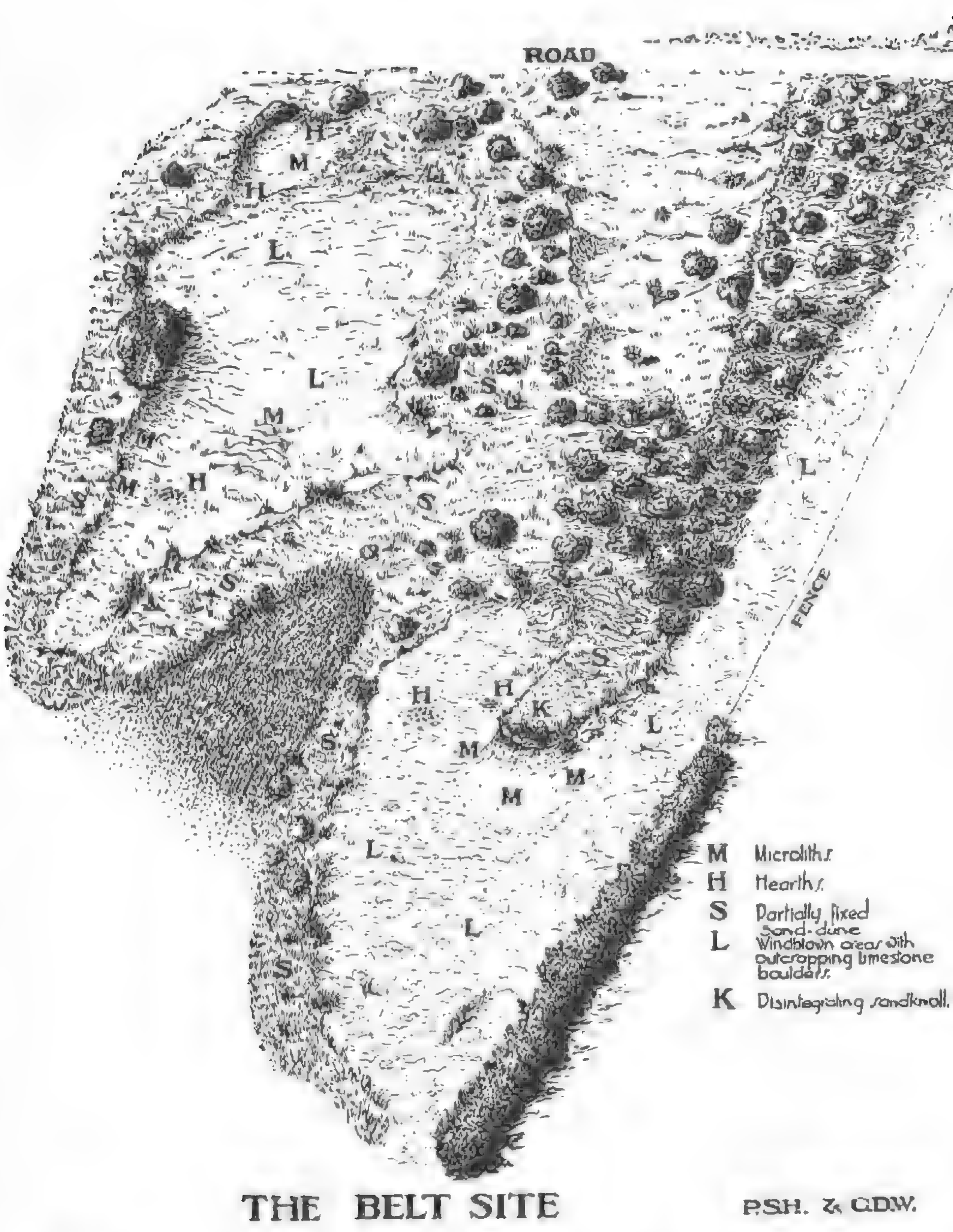

Fig. 3. M, Microliths. H, Hearths. S, Partially fixed sand-dune. L, Wind-blown areas with outcropping limestone boulders. K, Disintegrating sand-knoll.

WK. 9. This area is situated about 150 yards to the north of Wk. 8, in a blown-out depression on the brow of the same hill and well-exposed to westerly winds. It is considerably larger than Wk. 8 (see sketch plan, Fig. 2). An interesting feature is the large number of hearths, on some of which the burnt stones remain, well-congregated; on others they are more scattered.

WK. 10. This site is situated to the north of Wk. 9 in a depression at the base of the same hill. It consists of a small blown area about 25 yards in each direction. Only a few implements of any interest were found here.

WK. 11 and WK. 12. Only a brief examination was necessary to show that these sites presented little of interest. They occur on each side of a road which separates Section 125 and BI 3, Hundred Rivoli Bay. Neither area is well-sheltered and beyond a few widely-scattered hearth stones and scraps of implement debris, there was little of material interest.

THE BELT SITE (BT.). Although this site has already been described by Campbell and Noone, the abundance of implements and other features of interest it presented justified three further visits during the present investigations. Considerable numbers of specimens had been collected previously from this site, but an appreciable amount of useful material was again gathered. Among other features of interest, it may justly be styled as an intensive "factory" site; for the production of microliths was certainly considerable here, in addition to the many other kinds of well-made tools collected. Besides the 150 microliths gathered in 1943, the present work added approximately 200 more of these little tools. Some other features of interest concerning this site which were discussed previously, were further investigated. It had been suggested that the rock outcrops which are so abundant on part of the area might have been the source of material for implement making. An examination of the rock, however, shows that they are remnants of a consolidated dune and are in effect limestones, and totally unsuitable for the manufacture of stone implements of the types used and found on this site.

Further study of this area suggests that owing to its peculiar location on the extremity of the Belt ridge, it may have possessed similar "strategic" advantages for hunting, as were described for the Wk. 7, 8, 9 series. For there is ample evidence to show that the surrounding flats of this location were heavily flooded areas for months of each year, while the ridge itself would serve well for game driving tactics.

In the previous account of this site, mention was made of a buried hearth, revealed in the face of the eroded end of the sandy knoll, a prominent feature of this site. The hearth remnant, occurring below eight feet of sand, was examined more closely and was found to rest on a slightly consolidated sandy shelf which over a lapse of time has been buried beneath subsequent drift building up the upper portion of the knoll. Nearby on "ground level" were the scattered burnt stones of another hearth which had obviously occurred on the same firm shelf, but with the erosion of the knoll face has now been deposited as residual material on the lower level.

An excellent "bird's-eye" sketch of this site (see fig. 3) has been prepared by Miss Gwen Walsh. It is based on a chain and compass survey, with the help of photographs and many sketches drawn on location (see Pl. vii, Fig. 1). This sketch shows many of the characteristics of a typical aboriginal camp. The protecting elevations, the comfortable, well-drained areas constituting the "living quarters", the distribution of hearths, and the typical observed concentrations of microliths.

In general, the area is well-watered and the ridge to the south-east is still thickly timbered and must have supplied many sources of food (see Part III);

while the more depressed areas of the broad surrounding flats must have teemed with aquatic bird life for the wet months of the year. Altogether the Belt site is a striking and interesting one, in spite of the likelihood that since aboriginal occupation, erosion and drift, aided by the presenec of stock and rabbits, have altered some of its features.

LAKE FROME (FR. 1). This extensive camp site occurs on a low portion of a much disintegrated dune ridge which is possibly a north-western extension of what we now term Canunda Ridge. It is situated near the north-western corner of the present Lake Frome depression at the junction of Sections 74, 91 and 92, Hundred Rivoli Bay. It lies between the Woakwine Range and the shore of Rivoli Bay, and a detailed description of associated features and vegetation is given in Part III. At present, the area is highly eroded by wind action showing remnants of a partly consolidated ridge continuation (Canunda Ridge) and no doubt the site is somewhat different now from what it was at the time of native occupation. (See Pl. vii, Fig. 2). It would appear to be rather a camp for summer use, as the immediate surroundings to the north and east must have been exceedingly wet, swampy and untraversable in the winter season.

A useful and varied collection of implements was made here. Mollusc remnants were fairly plentiful.

LAKE FROME (FR. 2). This area contains a series of camp sites along the same ridge as Fr. 1, but two miles further to the south-east. It occurs in Section 96, Hundred Rivoli Bay. The north-westerly end lies just north of the railway line whence the successive camp areas extend in a south-easterly direction along the western side of the Lake Frome depression. It seems unlikely that this camp region was more than a temporary summer time location, as the immediately adjacent areas must have been heavily flooded in the wet season; and, apart from the tea-tree growth, the region affords little shelter. Implements were not plentiful, but a number of pounding and grinding-stones were collected.

CAPE BUFFON (BF.). This is a typical sea-cliff site situated on the headland at the south end of Rivoli Bay. It is on high ground facing the extreme southern corner of the Bay and sheltered from the prevailing winds by sandhills on three sides. It is protected on the west by a sandhill, more or less covered and fixed by typical coastal vegetation; on the south by a low ridge somewhat hardened by a mixture of light brown loam; and on its east side a large, drifting sand dune.

The main characteristic of this site is that it was probably a summer camp used when sea food was desired and obtainable. The wet season must have meant exceedingly bleak conditions and unfavourable to the collection of sea foods. A striking sight is the mass of shells of *Turbo undulatus* scattered over the whole area; and in those places where a number of large conical hearths still persist, these shells are concentrated into well-packed "middens." A few other mollusc shells were represented, but sparsely so. The *Turbo* remains predominate so remarkably that even if their relative durability is taken into account, they were the main sea food consumed. However, it is quite likely that other sea foods were also used; for fish, crayfish, crab, and the smaller gastropod remnants would be more easily blown away than the large, heavier *Turbo* remains. A small gap existing at the south-eastern end of the site could act like a funnel and the wind blast blow the lighter food debris down towards the sea.

This site at the back of the stony headland and with adjacent reefs exposed at low tide, appears to have been well-situated for the supply of all kinds of sea foods. Also, much of the country adjacent to the coastal dunes is well-covered with native vegetation and examination revealed a number of examples of indigenous food supplies, no doubt also available in aboriginal times (see Part II).

Another interesting feature of this site is the occurrence of flint nodules and boulders at high tide level on sandy patches below the sandstone cliffs. They are probably derived from offshore beds of Tertiary limestones; for it was noted that numbers of the nodules had been carried ashore entangled in the roots of some of the larger species of seaweed, pieces of which had obviously drifted in with the flint nodules attached. Such deposits were no doubt some of the sources of supply of the raw material used for the stone implements in this district. The Buffon site itself was littered with implements and implement debris; but only to moderate density. A few interesting implement pieces were collected.

LAKE BONNEY (CN. 1). This area was revisited during the present investigation and several other camp areas not examined in 1943 were included. Some additions were made to the implement collection from this area and it was again noted how the intense white "bleaching" of implement material from this Canunda Range system appears to be characteristic and contrasts markedly with the appearance of that from the more inland ridges and even from the Cape Buffon coastal site. There are no doubt several factors such as age, the nature of associated sand or soil, etc., which influence the colour and alteration of the flint material of which the implements are made.

Another point of interest noted is that while the mollusc shell debris is somewhat scanty, the *Plebidonax* type of bivalve is relatively frequent. No doubt this is again a matter of topographical relationships, for the shoreline of the ocean adjacent to this particular area (about one mile away) consists of a stretch of many miles of sandy beach where bivalves would be a far more important food than the univalves of rocky shores.

The close proximity of Lake Bonney must have been responsible for marked addition to the available food supplies.

BEVILAQUA'S FORD (CN. 2). This spectacular group of sandhills, associated with disintegrating consolidated dunes of Canunda Ridge, and its many camp areas, was revisted in 1944 mainly for geological observations. In the short time available a few further interesting implement pieces were collected and photographs taken. A group of typical native hearths is shown in Pl. vii, Fig. 3.

As described in the 1943 account, further observation confirmed that a whole series of camp areas lie along the eastern slopes of the sandhills. The latter are now undergoing considerable wind erosion which is causing the drifting sand to cover the camp areas and the live timber growing on the lower levels. The elevated and well-protected position of these camp sites must have made suitable living conditions, especially if one considers the close proximity of Lakes Frome and Canunda, and the sea and the well-wooded Woakwine Range not far away. The food and water supplies available suggest such an area capable of permanently supporting a considerable local group of natives.

REEDY CREEK SERIES. An interesting point concerning this group of sites is that they lie along the Reedy Creek Range which is the next main ridge to the east of the Woakwine Range and since both are consolidated former coastal sand dunes, the former predates the latter.

(RC. 1). This is a small sandy rise, near Gilchrist's Bridge, on the roadside by the Reedy Creek Drain on the east side of this ridge. The area is small and only a few implements were obtained. The location is in Section 66, Hundred of Kennion.

(RC. 2). A small roadside area on the east side of Furner settlement, near the section marked "Parklands" in the Hundred of Kennion. It is not large, being only about 50 yards long and 15 yards in width, and although rather an unpromising site for implements, a small collection of interesting pieces was obtained.

(RC. 3). This is the largest of these three sites, situated on a well blown-out roadside area at the north-west corner of the Furner settlement. Its surface has been well turned over by travelling stock. Only a few pieces were collected here and probably most material of interest is buried beneath the disturbed sand. The site, however, provided one feature of special archaeological interest, which is described later in the geological notes.

The country adjacent to these sites has long been settled and the land to the east and north intensively cleared. But nearby is the Reedy Creek Range, which is still extremely well-clad mostly with indigenous vegetation and is known to have supported native animals of many kinds (see Part III). Reedy Creek itself, before the days of drainage, was actually a series of connected swamps lying just east of the range and constituted a permanent and almost continuous waterway for many miles to the north-west in the direction of Kingston and beyond. In general this region was obviously well-supplied with food and water.

NANGULA (MR. 1). This site in Section 122, Hundred of Mayurra, has apparently been much used as a source of clean sand for local building purposes. But even now, a few flint flakes revealing previous aboriginal occupation can be found. Several pieces were removed from the sand "cliff" face, a few feet below the crest of the sand ridge, which in this region is associated with the Millicent limestone ridge. In the past a few well-worked implements have been collected here. It is likely that this site once formed a suitable camp location. Situated on the sheltered eastern side of a well-timbered ridge, it is also adjacent to the nearby flats which had a group of large important fresh water springs. Thus it was well favoured for food, water, and timber for dwellings and implements.

DISCUSSION. From the foregoing accounts, the following main points may be stated.

The territory under review has for a long time undoubtedly been a well-watered terrain, possessing a pleasant subtemperate climate with considrable vegetation and consequently abundant animal and bird life. It could, on the whole, be looked on as suitable for the support of an appreciable population of aborigines. In winter, however, widespread inundation of much of the country must have been a limiting factor to comfort and travel. For besides the almost continuous lake system between the Woakwine Range and the sea (from Robe down to the south-east end of Lake Bonney), wide areas of the Hundreds of Mt. Muirhead, Mayurra, Kennion, Symon, and Bray were vast expanses of swamp in the wet season. Such conditions were probably a limiting factor to population, in spite of the varied topography and abundance of vegetation and wild life.

Thus, considering the usual custom of aborigines restricting themselves to recognized "beats", it was likely that groups tended to be localized, and not in large numbers. This localization has already been suggested in the observations recorded by Campbell (1934). It also seems likely that whatever food supplies were available, protracted winter conditions would restrict the groups in this district to a somewhat settled life and nomadism was on only a limited scale. A study of the area and distribution of camp sites suggests that groups of natives could have lived, for example, on certain portions of the Woakwine Range, and there, with visits to nearby lakes and swamps and to the not distant ocean shores, secured a fairly stable, though perhaps at times, precarious, existence.

The above suggestions appear to be borne out by the existence of large campsite areas, for example, at the Bullock Island and Woakwine Station sites; these gave the impression of having been extensive, permanent camps, favourably situated on the eastern, sheltered side of the range. On the other hand, and taking weather and other environmental conditions into account, it seems likely that the coastal sites (Cape Buffon and Lake Frome) were more of a temporary nature and used only in the warmer and drier times of the year.

STONE IMPLEMENTS.

The following notes and tables provide a census and discussion of the stone tools collected. The amount of material gathered is considerable, and while the report gives a fair general account of the types and numbers represented, further intensive examination of the specimens will no doubt bring out other features of interest.

The following list is a census of the larger forms. SCRAPERS. Concave (65); Carinate small (46); Carinate large (13); Nosed narrow (19); Nosed broad (34); Nosed pointed (7); Casual (99); Discoid (10); Biface discoid (7); Semi-discoid 52); End (31); End, with side trimming (28); End, with double side trimming (23); Flat-end, double side trimming (9); Side (110); Side, inverse-trimmed (2); Double side (37); Double side, inverse-trimmed (23); Tula like (33). KNIVES (7). CLEAVERS large (6). BORERS (14). PIERCERS (8). NUCLEI (45). PEBBLE PERCUTERS (4). Total, 732.

The above total does not include "scrap" material collected, as included in the totals given by Campbell and Noone. Mr. Noone, whose expert knowledge is considerable, strongly advocates the collecting of a representative quantity of scrap, an examination of which often helps the appreciation of technical procedures involved.

The following list gives a census of the microlithic forms gathered during the present work, and the writers are much indebted to Mr. Noone for his kind co-operation in classifying this material.

Small bifaces (2). Small knives and saws (8). Symmetrical untrimmed points (12). Pirri-like point (1). Woakwine points, trimmed (214); untrimmed (32), failures (23). South-Eastern Bondi points: trimmed (100), unfinished (69), fragments (12). Buandik points (42). Piercers (7). Burins (1). Percuters (1). Scrapers: Squat-end (18); Discoid (12); Thumbnail (37); Butt-end (4); Side (39); Double-side (9); Concave (7); Carinate (9). Reduced tula-like (1); Nosed (1).

Geometric forms. Segments: Crescent (14); Half-moon (13); Rudder (18); Ordinary (24); Narrow (10); Cupid-bow (1). Triangles: Obtuse (17); Scalene (8); Isosceles (4); Brackets (4); Equilateral (2). Trapezes: Symmetrical (29); Asymmetrical (15); Spurred (18); Stigmate (1). Total, 849.

The above census does not include a few untrimmed pieces such as points, bladelets, and sundry flakes.

Grand total of implements collected (including special pieces mentioned below) 1,592.

The Buandik Point. The following notes written to one of us (T.D.C.) by Mr. H. V. V. Noone, provide a description for a batch of microlithic points he sorted out and for which he suggests the name "Buandik point". A somewhat long, isosceles triangular form, but mostly asymmetric; flattish like the Woakwine point; base nearly always trimmed and sometimes incurved; curved trimmed margin, generally left side; size fairly regular; in outline "like a canine tooth or fang". Specimens illustrating this type are shown in Figs. 96 and 97, and Fig. 138 of two papers by Campbell and Noone, published in 1943.

Other forms of implements not included in the above lists and requiring separate description.

BIFACE FLAKED PEBBLES (described by Stapleton, 1944). One large and one small; poor, partly worked tools. From Buffon and Frome 1.

POLISHED END AXEHEADS (basaltic rock). One medium size, oblong; (Wk. 5). One small, round, 4 in. diam. (Wk. 7). One half portion of a medium size implement (Wk. 7). Fragment of polished end of an axehead (Belt).

One implement, similar in shape to the typical polished-end axehead, but made from a seldom used and rather soft sedimentary stone, from Fr. 1.

GRINDING SLABS. Two, round in shape, 6 in. and 8 in. diameter. From (Wk. 5) and (Frome). Both are of a quartz porphyry, which material Sir Douglas Mawson identifies as coming from near Keith, some 80 miles to the north-east.

ANVIL SLAB. Approximately square in shape, 7 in. Consisting of a slab of tough sedimentary limestone.

Seven pieces of ochre or ochreous material; 5 from (Wk. 8), 1 from (Fr. 1), 1 from (Belt). This material was probably derived from the west side of the southern Mt. Lofty Ranges.

One small percuter or pounding tool, oval in shape (about 2½ x 2 x 1 in.), from site Wk. 9. Consisting of a piece of reef quartz.

It is interesting to note that the ochreous stones and the granitic implements must have been brought from a considerable distance. No present outcrops of granite occur south of Kingston. The ochre had been transported probably for over two hundred miles.

DISCUSSION ON IMPLEMENTS. Some general discussion on the main points concerning the stone industry of these aborigines has already been given in the paper by Campbell and Noone (1943), so that it will not be necessary to add more than a few general remarks on the findings of the present research.

The collection made shows conclusively that the vast majority of implements were made from flint; and the deposits of this material on the coast were no doubt the source of most of the raw material for their manufacture. Some evidence of this was seen at Cape Buffon. But it is believed that the well-known large flint deposits further along the coast to the south-east were the main source of supply for the lower south-east.

With vast quantities of eminently suitable material at their disposal, it seems a little surprising that a generally higher stage of flint working technique had not developed. For collections made over past years gave students the impression that, on the whole, these aborigines displayed poor knowledge of the possibilities in stone implement manufacture. Much of the material recently gathered also shows somewhat rough and ready treatment in design and purpose. But the finding by Campbell and Noone in 1943 of large quantities of beautifully made microlithic tools, together with the large number collected during the present investigation, has modified the earlier impressions. It confirms the idea that while these natives seemed content to make many of their larger implements by trimming almost any sort of poor irregular flake, when the microlithic forms were concerned, they displayed a sound appreciation of core handling and flake detaching, and possessed a good knowledge in producing minute points of excellent fineness and design.

The collection of so many more of these microlithic forms also confirms the occurrence of this particular industry in far more southerly regions than had hitherto been believed. Also the further establishment of quantities of both Boudi and Woakwine points, and the recognition of still another form of microlithic point—Mr. Noone's suggested "Buandik" point— show that the native possessed a sound appreciation of the principles involved in making these delightful little implements.

A few points of comparison between the census figures given in the above lists and those of Campbell and Noone may be of interest. The present collection involved a larger number of camp sites than that examined by the previous workers, whose figures are given in parentheses:

Bifaces, 7 (22); Knives and saws, 7 (61); Piercers, 8 (10); Discoid scrapers, 10 (92); Semi-discoid scrapers, 52 (6); Casual scrapers, 99 (35); Nosed scrapers, 53 (96); Side scrapers, 172 (74); Concave scrapers, 65 (62); Carinate scrapers, 4 (34). Geometric pieces: Segments, 69 (34); Triangles, 35 (36); Trapezes, 63 (35); Percuters and Trimmers, 4 (36); Nuclei, 45 (18). Grinding slabs, etc., 3 (4).

Grand total of implements collected during the work of Campbell and Noone and the present investigations, 2,756.

During the present work, an appreciable collection was made from the Belt site; but as this area had already been examined by a few other collectors, and especially by the intensive collecting of Campbell and Noone, a good deal of our material tends to include a certain amount of "second grade" specimens.

The important problem of the relative ages of implements as suggested by the different "weatherings" is discussed (by P.S.H.) in a later section of the paper dealing with geological notes.

PART II.

In February, 1945, a further trip to the Lower South-East was made by practically the same team of workers as in 1944. For this more recent field work the region chosen was the Hundred of Kongorong in County Grey, which occupies the coastal area to the south-east of Lake Bonney and is about thirty miles from the main area of the 1944 survey. (See map).

The working party consisted of J. B. Cleland, T. D. Campbell, P. S. Hossfeld, T. Vogelsang and Misses G. D. Walsh and A. Harvey.

The main objects of the 1945 trip were (1) to study another part of the Lower South-East which would carry investigations to an associated area but further along the coast to the south-east; (2) to investigate the important Buandik biface implements recently described in these *Records* by Stapleton (1944)—who collected them many years ago—and represented in the South Australian Museum by interesting specimens from the Kurtze collection; (3) to study the main sources of flint material used for South-East implements; (4) to investigate the possible further southerly extension of microliths; and (5) to study in general the ecology of this group of the extinct Buandik aborigines.

General Topography. The Hundred of Kongorong differs in several respects from the terrain similarly situated near the coast above Lake Bonney. In general, the Kongorong country adjacent to the ocean appears to be a better type for vegetable and animal life and thus for human occupancy. This is partly due to the fact that from the north end of Lake Bonney up to Robe (about fifty miles to the north-west) the country lying between the sea and the Woakwine Range is mostly occupied by a series of lakes and, in the past, by undrained, swampy flats. Another, and perhaps the chief factor, appears to be the occurrence at, or just beneath, the surface of Tertiary limestones, which here have produced soils of a better type in general than those produced further to the north-west from wind and ocean sorted sands and later swampy and lake deposits.

The Woakwine Range continues south-easterly into the Hundred of Kongorong as a low range which appears to have no definite official or local name. We therefore have given the name "Kongorong Range" to that portion of this important South-East ridge system lying in the Hundred of Kongorong and commencing to the east of the lower end of Lake Bonney and continuing in a south-easterly direction. The land between the Kongorong Range and the sea is undulate; and although it contains a number of extensive swamp areas, it seems in general to be better drained than the coastal strip to the north-west of Lake Bonney.

The chief undulations between the Kongorong Range and the sea are two fairly definite minor ridges. These ridges appear to have no official or local names, so for convenience of our study and descriptions we have applied to them terms which have been given officially to adjacent parallel depressions and have named them the "Whawbe Ridge" and the "Long Gully Ridge."

We have learnt from old inhabitants of the district that this now mostly open Kongorong country was, sixty to seventy years ago, heavily clad with timber, so much so that "one could scarcely see more than fifty yards ahead." The early settlers in the district ringbarked most of the timber which later was almost completely obliterated by one or two big bushfires.

The western coastal portion of this Hundred is level country, now drained to some extent by two small artificial outlets to the sea; but further to the south-east extensive swamp areas still persist. The earlier lands surveys indicate the former existence of numerous swamp areas and springs.

In general, it may be said that this area has always been a well-watered terrain.

A short paper by S. R. Mitchell (1943) gives an account of a visit to this area. His report contains some geological notes and mentions that "seven sites were examined and a large number (240) of implements collected." No descriptions or locations of the camp sites are given, nor any detailed classification or census of the implements gathered. It is stated the camping places are on the "Kongorong Hills," all the camps being "at least five miles inland." If these hills are the same as those we have called the Kongorong Range, then the sites of this writer are not the same as, or further inland than, those we examined—the latter being about three miles from the sea. The presentation of the data in the paper by Mitchell was probably necessarily brief, and therefore it is difficult to use them for comparison with those of the present work.

Area Investigated. The working base of the party was located at a small limestone point on the coast known as Blackfellows Caves. From there various journeys were made to look for and study such camp site remnants as could be located. Information previously obtained from Mr. Kurtze, of Portland, who had collected aboriginal implements in this region some years ago, suggested that camp sites would be fairly plentiful. Our survey showed this to be correct. Excepting at certain areas where swampland lies close to the sea, almost the whole immediate coastline presents a continuous series of camp site remnants. Camp areas also occur on the ridges lying inland, especially on the Kongorong Range. Preliminary reconnaisance was made for a few miles along the coastal areas to the north-west and the south-east of our base and also to the inland ridges so that the more promising sites could be selected for further detailed study.

The map shows the locations of the main camp areas located, and those given special attention are described below. All the sites occur in the Hundred of Kongorong, and their location has been determined by recording the section numbers in which they occur.

DESCRIPTION OF CAMP SITES.

CAPE BANKS (CB. 1). On the clifftop of the main Cape Banks headland (in Section 407) is a small sloping windblown hard area which is still profusely littered with scattered burnt hearth-stones and the remains of *Turbo undulatus*. Remains of *Cellana* were also in evidence. It was obvious that this cliff camp area had once been more extensive, as its lower border is abruptly broken away by collapse of the cliff edge.

CAPE BANKS (CB. 2.). This camp area is one of special interest as it appears to have been mainly devoted to "factory" purposes. Not large in area, it is situated about one mile south-east of Cape Banks (Section 500) and occupies the inner slopes of the sand dunes immediately on the shoreline and the narrow depression between these dunes and other low bush-covered dunes a few yards inland. See sketch, fig. 4. An important feature associated with this site is the vast bank of flint pebbles occupying the higher beach level on the immediate sea side of the dunes. The surfaces of several dome-like portions of the sandhills were literally packed with flakes and broken pieces of the flint pebbles; and this debris was also thickly strewn over the lower hard base level of the site. Quite an appreciable collection of worked pieces was made on this site, especially of microliths, a large number of which were obtained from the slope of one particular sand eminence, otherwise there were but few remants of previous aboriginal occupation beyond the remains of a number of fire hearths and scattered mollusc shells.

The main interest of this site is in its obvious use, right at the source of the flint material, as a manufacturing "depot" whereat the pebble cores were broken up into suitable flakes from which implements were either trimmed up on the spot, or made at some other permanent camp.

BLACKFELLOWS CAVES SITES. (KBC.). These sites formed a series in the vicinity of this small wave excavated point (Section 393 E). Two small areas, one on the top of the low point itself and another on a sandhill slope nearby, are similar in a general way to the two Cape Banks sites just described. They presented a variety of flint flakes and occasional microlithic pieces, flint debris, and scattered mollusc shells. A number of more or less connected sites are situated to the immediate south-east of the point, and these presented certain features different from the above mentioned and in some respects of high importance (see Pl. vii, Fig. 4). Various pieces of evidence suggest that the levels on which these particular camp relics occur are the result of long periods of change in the immediate topography. These areas gave the appearance of there having been higher levels, which have been eroded and reduced, ultimately reaching a hard blackish "floor," on which the archaeological material has been deposited as residual material. This special feature will be discussed later under geological notes. From these level areas large numbers of worked implements were collected, mostly microlothic forms of the Bondi, Woakwine, and Buandik point type. Hereabouts were also found a few poor-grade specimens of the Buandik axehead. Larger types of implements of the scraper variety were rather sparsely represented. Mollusc remnants were sparse. The nature and situation of these implement carrying flats suggest the unlikelihood of them having been used as camp sites in their present form. A flat, firm area of ground which appears to be damp for most of the year is quite unlike the usual camp site. And as suggested above, it seems likely that this strip of shoreline had previously been occupied by sand dunes, the slopes of which would have provided more typical camping places. These possible changes involve the interesting geological question of the nature and age of changing topography of this particular ocastline.

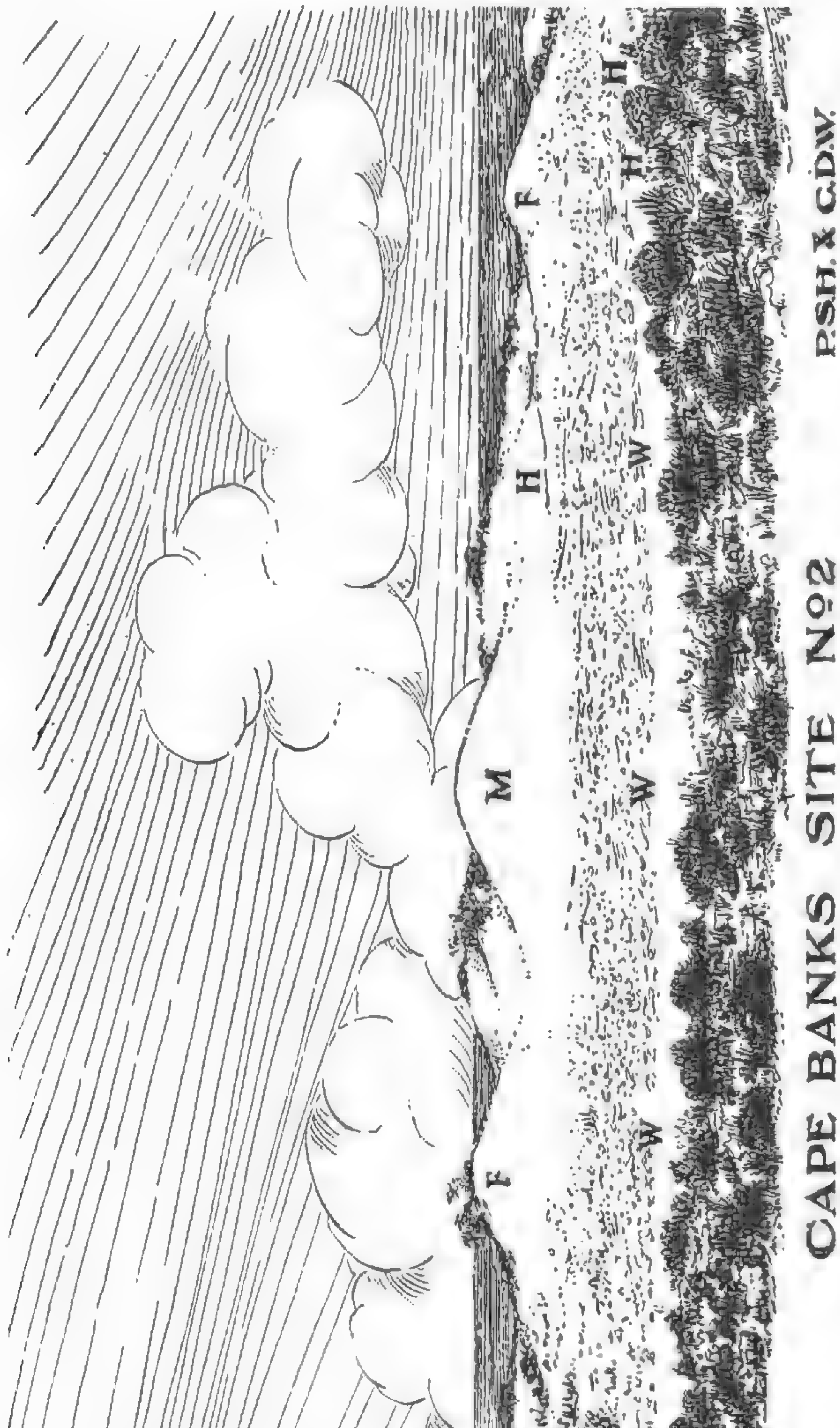

Fig. 4. H, Hearth remnants. M, Microliths. F, Flint flake debris. W, Wind-swept area.

BLACK ROCK SITES. (BR. 1 and BR. 2). These sites are situated about one and a half miles to the south-east along the coast from Blackfellows Caves (Sections 392 and 390), and might also be considered another series of more or less connected camp areas. They, too, are situated on the hard, dark level base lying between the shore dunes and the big spectacular sandhills which along this region lie a hundred yards or so inland. On these also the implements collected were mainly of microlithic forms, with a scarcity of larger implements. In places these flat areas were covered with a thin layer of drift sand which made collecting more difficult. Site BR. 2 was particularly interesting for the profusion of microliths on two or three quite small areas; and another striking feature of this latter site was that its south-eastern end merged on to rising ground, built up in parts to sandhills, the firmer slopes of which were strewn with tremendous quantities of *Turbo* shells. Scattered burnt hearth stones were also much in evidence.

MAGGOTTY POINT SITE (MP.). Situated (Section 388) about two miles or so further to the south-east of the Black Rock sites. This expansive area which covered proably four or five acres was quite similar in general characteristics to those of the Black Rock region. But to the immediate inland of this area, more or less permanent swamps occur. Microliths were moderately plentiful, and here larger implements and flake debris were more plentiful than on the other similar coast sites. Scattered hearth stones and some mollusc shells were observed.

LONG GULLY RIDGE (LGR. 1). This site consists of an area about quarter of a mile in length on the inland slope of Long Gully Ridge (in Section 477). Here this ridge is rather low, probably not more than thirty to forty feet above the level ground on the inland side. The camp area remnants are rather small sand-blown patches on the upper and lower levels of the ridge and give the appearance of an old site which had not been occupied for a considerable time. The lower levels have been covered with silt deposits. Here and there are scattered hearth remains. Considering the size of the areas with exposed implement material, quite a large collection of pieces was made. Most of these are larger pieces of the scraper type—much more frequent than on the coastal sites. A few microlithic specimens were also gathered, but these, on the contrary, were not nearly so conspicuous as on the coast sites.

WHAWBE RIDGE SITE. (WR. 1). A small area on the higher slopes of the inland side of this Ridge (in Section 489). This area was not very productive, providing only a few pieces of scraper types of medium size.

KONGORONG RANGE SITES. (KR. 1, KR. 2, KR. 3, KR. 4, KR. 5). Numbers 1 and 2 (Section 479). These are much eroded, wind-blown areas situated on the western or ocean side of the Range—not a typical situation for camp sites. Erosion has exposed many blocks or "pillars" of limestone, and among these were found scattered implement material, mostly of the scraper variety from medium to large sizes. Many are of the casual or poorly trimmed type of scraper, though occasionally examples of symmetrical, well-trimmed tools were found. Only a few of the micro types were collected. Scattered hearth remnants also occur.

KR. 3. (Section 479). This, in general features, is similar to the above sites, but occupies a fairly sheltered depression on the crest of the Range a little further to the south-east. It presented a few scattered hearth remnants and medium-sized scrapers.

KR. 4. (Section 479). This consists of a series of rather small wind-blown and rain-washed areas on the inland slopes of the Range to the east of sites KR. 1 and 2. On these some good examples of medium to large size scrapers were collected, and another interesting find is a fragment of one of the typical Lower South-Eastern basalt stone axeheads—portion of the ground and polished end of the tool. Remnants of scattered hearths also persisted.

KR. 5. (Section 475). This is an imposing, extensive area covering some acres, situated on the inland, eastern side of the Range and occupying the slopes of a large valley. Here again extensive erosion has occurred and vast quantities of sand have been washed down on to the lower parts of the slopes and into the gully floor below. Here, as with the other sites on this Range, the disappearance of native timber and subsequent stocking of the country have probably contributed largely to the intensive erosion process which has taken place. This large area produced many good examples of the medium to large scraper types of implement. One specimen found is a beautiful example of a large hand axe or chopper implement made from a large elongate oval flake about 22 x 12 x 3 cms. It is trimmed along the margins of only the outer face. (See fig. 8). Some parts of this large area also presented numerous exposed limestone pillars, and an examination of these showed that when the area was used as a camp, these stone masses must have been almost completely hidden, for numbers of them showed the crestal portion burnt by fire. Since then, the surrounding sand has been eroded away to a depth of two to three feet in some places.

DISCUSSION. Considering the distribution and nature of these camp sites in general, the following points may be discussed.

As with the camp sites previously studied in the Millicent-Rendelsham region, it seems likely that those adjacent to the shoreline were of a temporary nature. The somewhat protracted winter season of this Lower South-East coastal terrain with its inclement weather would tend to make littoral camps uncomfortable quarters. More likely they were visited during the summer months when conditions for fishing, gathering molluscs and other sea foods would be more amenable. Moreover, the inland sites would afford better protection from the prevailing westerly weather, provide suitable and readier material for habitations, and better drained locations for the latter. There is ample evidence for belief that the ridges were well covered with timber and vegetation, thus supporting plenty of animal life for food supplies, while the adjacent swamps and springs would provide ample fresh water suplies and attract bird life.

Two important features of the coastal sites call for comment. The abundance of mollusc shells on the sites and the consistent manner in which the outer lip of the shell was broken in the predominant *Turbo* indicates that these sites were used as feasting places for this kind of sea food. This was particularly marked in the case of Black Rock site No. 2. Then it is obvious that some of these camps were also used for the preliminary work in fashioning implements from the abundant sources of flint pebbles, vast beds of which line portions of the shoreline nearby. Cape Banks site No. 2 is a fine example of this industrial activity. On the other hand, the inland sites were almost devoid of remnants of sea foods; and the flint debris and implements provided an entirely different picture.

The special distribution of implement types is clearly revealed in the campsite contents. Microlithic forms were outstandingly predominant on the coastal sites, and the larger forms of implement, of the medium to large scraper varieties, were scarce; whereas the latter formed the vast bulk of the material collected from the inland sites, and the miniature types were almost a rarity.

Taking a broad view of the size, number, and distribution of the camp sites of this region, the general impression was gained that, in spite of its likely productivity, it did not hold large numbers of natives. It is suggested that by attempting to visualize the numbers of family groups who could occupy the various camps, a total of one hundred individuals for the Kongorong area might be a reasonable estimation of population. It will thus be seen that the ecological approach in a study of camp sites provides a possible objective basis for estimating density of population in any particular district. It is intended that more intensive treatment of this matter will form the subject of a later publication.

STONE IMPLEMENTS.

Material Used. With extremely few exceptions, all the implements collected were made from flint. This is only to be expected, as vast quantities of this suitable material were available close at hand on the coast.

Distribution. The main points concerning the distribution of the various kinds of implements collected may be stated as follows: (1) The vast majority of microlithic forms collected—at least 98%—occurrred on the sites immediately adjacent to the shoreline. (2) The majority of the medium to large varieties—approximately 94%—occurred on the inland ridge sites. (3) The axehead or chopper type of tool in the form of flaked pebbles or large trimmed flakes were found mainly on the coastal sites. But, concerning these, it must also be(mentioned that Messrs. Kurtze had previously collected extensively over these areas and gathered only the large kind of implement. Thus it is likely that many of these Buandik axeheads had gone before the present examination and those found represented the poorer "leavings."

The following lists give a census of the collection made on the present trip. But as the number of implements taken is appreciable, the classification must be considered somewhat tentative, as much more intensive examination is required to make the study complete.

SCRAPERS. Concave (14); Nosed (26); Side (47); Side with inverse trimming (4); Side, large irregular forms (26); Double-side, trimmed (19); End, with side trimming (20); End, with double side trimming (14); Flat end, some with side trimming (10). Scrapers of tula-like trimmed flakes (46). Carinate (6); Carinate with point (1). Discoidal (4); Discoidal biface trimmed (1); Semi-discoidal small, (16); Semi-discoidal, large (13). BORERS (2). PERCUTERS (6). CONICAL NUCLEI (10).

POUNDERS. A point of importance is that very few of these tools were found. Of special interest was a pebble-like pounder about 10 cms. in diamter and 4 cms. thick, with a well-worn periphery and a central pitted depression on one side. It is of a highly siliceous granitic rock, a material from probably over 100 miles away from the Black Rock coastal site on which the implement was found. One of the percuters was of unusual stone for this area— a piece of hard, red quartzite, probably from the Mt. Lofty Ranges.

AXEHEADS, BUANDIK TYPE (Stapleton). Partly worked biface implements: Small size (up to 10 cms. in length), 9. Large size (most poorly worked, several broken), 19.

AXEHEADS, POLISHED END. One half-portion of a polished-end axehead (made from basaltic rock) was found on the Kongorong Range. Site KR. 4. Also a small fragment of the polished end of a similar tool was found among the material collected from one of the coastal sites. We have since learnt that another of these polished axeheads has been found in this area.

LARGE CLEAVER (?) type of implement. Among the larger kinds of implements collected were eight specimens made from large irregular flint blocks (15 cms. to 20 cms.) poorly trimmed along one or more margins.

SPECIAL FORMS not included in the above list and meriting separate mention:

A large leaf-shaped flake (9·5 x 5·5 cms.) with left margin trimmed (See fig. 5). From KR, 4 site.

A large discoidal flake (9 cms.) with uniface marginal trimming. (See fig. 6). From LGR. site.

A small biface worked tool (8·5 x 4 x 2 cms.), like a small Buandik axehead. (See fig. 7). From MP. site.

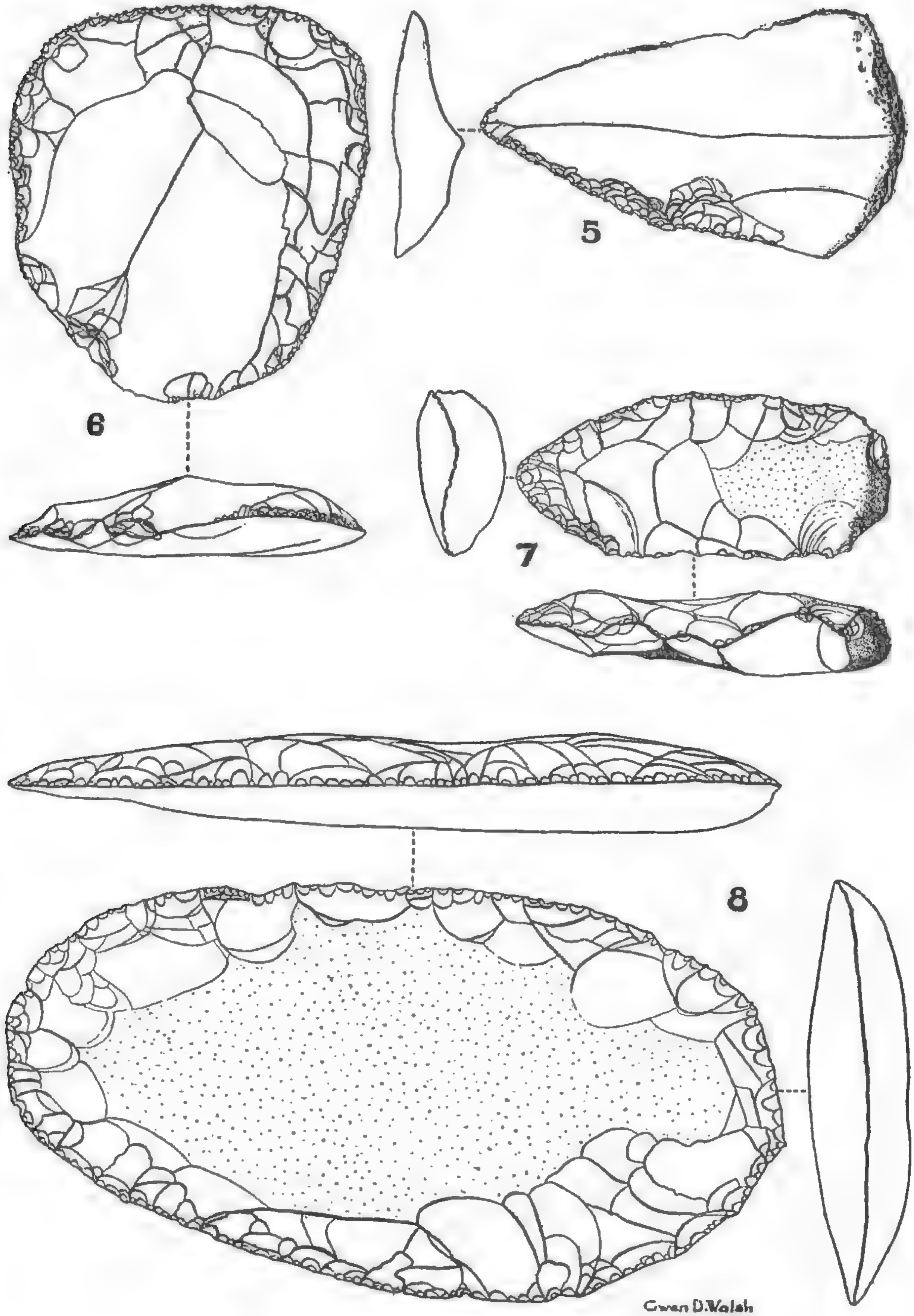

Fig. 5–8. Special Stone Implements (half nat. size).

A large elliptical flake (22 x 12 x 3 cms.) implement with continuous marginal trimming on one side only. A beautiful tool. (See fig. 8). From KR. 5 site.

Nine large (all over 10 cms. in length), somewhat rectangular, flat-end scraper (?) tools; some with side trimming. From inland sites.

Scrap pieces collected, such as some untrimmed flakes, bladelets and points, have not been included in the above census. Total, 327.

The following points are given concerning the above.

Among the tula-like trimmed flakes (included in the scraper list) are a number of large-sized tools (8 cms. and over), which are exceedingly well trimmed.

The side scrapers are mostly poor examples made from rather irregular flakes. The so-termed "large size" side scrapers, all about 12 cms. or over, assume the form almost of a cleaver or a light chopper type of tool.

A point of significance is that of all the medium to large sized implements, in approximate figures, only twenty were from the coastal sites, whereas over three hundred were collected from the inland sites.

MICROLITHIC TYPES.

POINTS. South-East Bondi Points. Micro forms. Complete (115); with broken tips (48); poor and partly trimmed (51). Larger forms: Complete (89); with broken tips (43); poor and partly trimmed (58).

Woakwine Points. Micro forms: Complete (169); with broken tips (13). Larger forms: Complete (89); with broken tips (9).

Buandik Points. Micro forms (52); larger forms (15). Bondi and Woakwine form flakes untrimmed (37).

Asymmetric Points trimmed (1). Total Points, 789.

SEGMENTS. Ordinary (9). Narrow (6). Rudder form (7). Crescents (1). Half-moon (3).

TRAPEZES. Symmetrical, with untrimmed upper margin (7).

PIERCERS (1). SCRAPERS: Side (7); Double sided (1); Semi-discoidal (5). Total Microliths, 836.

Concerning these microlithic implements. The "larger" forms included are actualy longer (some measuring up to 6 cms. and a few even longer) than the standard of up to 3 cms. prescribed for "micro" types. But even though beyond such a dimensional standard, these longer specimens—most of them not being much above 3 cms.—so obviously belong to this point suite, that their inclusion here is considered justified and convenient.

The Woakwine points, with very few exceptions, are all trimmed from the left side. Also included are occasional pieces with trimmed butt, some of these also being spurred butts.

A feature of interest is that out of a total of over 800 microlithic forms (including "larger" forms), the vast majority were collected from the coastal sites; only 13 specimens being taken from sites on the inland ridges.

DISCUSSION ON IMPLEMENTS. While this large collection provides scope for considerable detailed work, a few points of special interest may be mentioned.

One striking feature is the large number of small "points," mainly of microlothic dimensions, which occur on the coastal sites in association with the vast quantities of *Turbo* remains. A study—discussed in Part III—of these shell remains gives some indication of how the aborigines treated these molluscs in order to extract the "meat"; and it is suggested that the use of these small flint points (especially the larger Bondi and Woakwine pieces) was as a pick to remove the creature from its shell.

The preponderance of the scraper type of implement on the inland sites seems to suggest that possibly their occurrence and use there were associated with the making of wooden implements, suitable raw material for which was more likely to grow on these parts.

The collection of large numbers of microlithic forms from this Kongorong region establishes the definite occurrence of this interesting industry still further to the south in this State than was previously known. Their collection during previous work in the Millicent-Rendelsham area (1943 and 1944) brought to light the rather unexpected intensive knowledge and use of microlithic implements by the Lower South-East aborigines. So this further southerly extension not only confirms the previous findings, but also adds to the general interest of this particular study.

Grinding stones appear to be particularly rare—indicating that the grinding of seeds for food material was uncommon. This is also supported by the investigation of possible supplies of plants which would yield such seed material.

Like the implements collected during the 1944 work, those gathered in the Kongorong area also showed the characteristic "weathering" of the flint material. Discussion of this feature is made in the geological notes.

Brief notes on the Lower South-East microliths.

Combining the figures available from the work of Campbell and Noone in 1943 and those of the present investigation, the following comparisons disclose interesting facts.

Totals of implements collected. 1943: General (749); Microliths (289). 1944: General (732); Microliths (489). 1945: General (327); Microliths (836). Thus the microliths, totally outnumbering as they do the larger types (1974 to 1808), appear to have been an important part of the stone tool industry of these natives.

The 1943 microliths form about one-third of the total implements collected. Of these microliths, nearly all were collected from one site—The Belt, which seems to have been a veritable "factory" site. For 1944, in the same district, but entailing work on many more sites, the number of microliths actually exceeds the total of the larger forms gathered. While in 1945, from the Kongorong area, the microliths outnumber the larger forms in a ratio of 2½ to 1.

Distribution. In 1943, in approximate figures, 200 microliths were found on inland sites—Woakwine and Belt; and 89 from sites near the coast. For 1944, for the same area, though from more sites, the corresponding figures are 750 and 130. But for 1945 in Kongorong, similar locational figures are respectively 13 and 826. Thus for the Millicent-Rendelsham and adjacent coastal parts, microliths on inland sites predominate over coastal sites by 4 to 1; whereas in Kongorong the position is completely reversed, and microliths occur almost exclusively on coastal sites.

Frequency of "points." Further analysis of figures reveals the importance of points in this microlithic industry—that is, in particular, the Bondi, Woakwine, and Buandik points. For 1943, out of a total of 289 microliths, 151 were points; for 1944, corresponding figures are 849 and 473; for 1945 in Kongorong, 836 and 789. Thus in the frequency of microliths collected, just over 70% of their total number are points. There must be some significance in the vast production of these small, well-made, and often extremely delicate, finely pointed tools. It was suggested above that they may have been used as a "probe" for extracting the mollusc meat from its shell. This seems a likely use, considering the frequency of point tools where shellfish were obviously consumed in vast quantities. The larger sizes of Bondi and Woakwine points seem well suited for such usage. Whether the small, fine specimens were also thus employed may be open to question.

It is interesting to note that New South Wales Bondi points are also collected mainly from littoral sites.

However, the whole problem of Australian microliths seems to be wrapped somewhat in obscurity. Their makers became extinct before any knowledge was gained of even the existence of these little tools, much less of their uses. As regards their frequency and distribution in the areas under present investigation, no doubt various factors will have to be considered in further study. For example: The problem of concentrations of implements on certain sandhill sites, due or not to redeposition on to lower levels. The possibility of relationship between frequency of occurrence and immediate flint sources and food supplies—as on the Kongorong coast. Their greater frequency on inland sites in the Millicent-Rendelsham area may suggest a need for more intensive search for coastal sites there. The study is full of interest and fascination.

GEOLOGICAL NOTES.

The topographical features of the Lower South-East and their development have been described in general terms by a number of previous observers (Tenison Woods, Howchin, Ward, Fenner, Tindale, Crocker). However, the elucidation of the complete story and significance of the various features will require a considerable amount of detailed and specialized investigation. This was obviously impracticable during the two short periods available, and attention therefore was directed towards those features which appeared to have a bearing on the problems of aboriginal environment and antiquity of occupation of the region.

Although opinions are still divided on the question whether in this region sea level has dropped or the land risen since the formation of the first and most inland series of stranded and consolidated coastal dunes, the Cave Range, everyone is agreed that the Lower South-East, as a region, was covered by the sea in comparatively recent times, and has emerged as a land surface by successive stages to form the land as we see it to-day.

The present investigation is concerned only with the area between Douglas Point on the south, Rivoli Bay on the north, and inland as far as the Reedy Creek Range. Within this area the Reedy Creek Range is the most inland and oldest series of stranded coastal dunes. Proceeding at right angles to this range towards the coast and therefore in a south-westerly direction, the next large series of dunes encountered is that known as the Woakwine Range, which continues to the south-east into the Hundred of Kongorong, where it is represented by the Kongorong Range and possibly in its later stages by the Whawbe Ridge and finally the Long Gully Ridge. Near the coast another ridge appears which has been named the Canunda Ridge. This, however, does not continue far south-east of the north-western end of Lake Bonney; its former extension to the south-east, if it existed, having been eroded by the sea and covered by its incursion. Still further to the south-west, one finds isolated remnants of still another former coastal dune, which was partly consolidated and probably formed a continuous series, of which only a few headlands remain, such as Cape Buffon, Carpenters Rocks, Cape Banks, etc. Finally there are the present coastal dunes which, however, do not exist as a continuous series everywhere. They are particularly well developed on the coastline between Cape Banks and Cape Buffon.

We have therefore in this area five major series of coastal and former coastal dunes, each evidence of a former shoreline which remained stationary for a period long enough to permit the accumulation of the material forming the dunes. There are also several minor ridges indicating the existence for relatively short periods of other intermediate shorelines.

Evidence collected suggests very strongly that the land has emerged from the ocean by stages which were unequal, irregular in duration, and exhibited intermediate periods of retrogression, the net result, however, being one of emergence of the land. Further investigations into this problem are proceeding. For the purpose of the present paper, the investigation of the relative ages of these former coastal dunes is essential, as once these are established, the search for native remains or artefacts contemporaneous with the formation of the dunes will assume great importance. Time did not permit a detailed search over the large area involved and, although so far little has been found, some evidence of contemporaneous native remains and possibly of their antiquity has been collected.

In 1944 blackened limestones containing free carbon were found embedded in the consolidated dune limestone of the Reedy Creek Range and of the Woakwine Range. The former occur at the camp site labelled RC. 3, at the north-western corner of Furner settlement. Here, a number of fire-blackened stones occur in the consolidated dune limestone and present the appearance of a scattered hearth like those which occur on recent camp sites. This occurrence appears to have been a hearth contemporaneous with the existence of the Reedy Creek Range as an unconsolidated mass of dune sand.

The second occurrence is at the camp site recorded as Wk. 7, about two miles to the south-east of the old Woakwine Station. A number of fire-blackened stones occur here within a small area and embedded in the consolidated dune rock. These, like those in the RC. 3 site, appear to be stones belonging to a dispersed hearth.

In 1945 a blown-out area near Woody Point in the Kongorong Range yielded a few native artefacts and also a number of fire-blackened stones. The latter were embedded in the consolidated dune rock. They consist of a number of flat pieces and some irregular fragments of blackened limestone, and, as in the other instances, resemble closely the scattered hearths found on recent camp sites.

Although so far no artefacts have been discovered embedded in the consolidated dune limestones, this does not by any means rule out their existence in these rock types. Not only was the search for such remains necessarily brief, but it must be remembered also that even in a well-established camping area artefacts are often scarce except in very limited portions; and further, the concentrations by wind erosion and removal of the superficial sand concentrates on the hard floor the whole of the solid material previously distributed vertically above it. No such concentration can take place in the case of embedded artefacts, for once these have been released from the containing rock they lose their identity and become part of the loose surface material.

Another notable feature, the detailed study of which promises to yield important information on the relative ages of artefacts, is the varying degree and type of alteration that the flint of which they are made has undergone. Although fresh, unaltered flakes and chippings occur, the vast majority exhibits degrees of alteration depending to some extent apparently on the location of the camp sites. Thus the coastal sites and some others, such as the Lake Frome sites situated two miles inland, carry artefacts which in nearly all cases have a white appearance. This bleaching extends for some distance into the specimens. In the case of small thin flakes, the alteration may be complete, but in most pieces the central core is unaltered and exhibits the original colour of the flint, the unaltered core reflecting in its configuration the external shape given to the artefact by its aboriginal manufacturer.

The inland sites, such as those occurring on the Woakwine and Kongorong Ranges, the Whawbe and Long Gully Ridges, the Belt Site and others, carry flints which appear to have weathered in a different manner. Those which have been altered exhibit various shades of yellow and brown. This colouration is chiefly

a surface stain and the flint has been altered to a white or cream coloured material, similar apparently to that on the coastal sites. The chief difference seems to be the presence of ferric oxide, probably in a hydrated form both as a surface skin and also dispersed to some extent through the white alteration product of the original flint. On some sites, notably the Long Gully Ridge, alteration of the flints has gone so far that flints of the size of small boulders have been changed completely to a softer white material. That such boulders once consisted of flint is shown by the fact that until they are lifted or struck they are indistinguishable in colour, appearance, and shape from solid, unaltered flints, and also that some of them still contain a core of unaltered flint.

These alterations are believed to be due to the loss of water which is combined in variable amounts with the silica in the original flint. The slow dehydration under atmospheric conditions gradually produces the white alteration product which, however, is still silica and of similar hardness. The relative depths to which this alteration has progressed in this district may well be regarded as a line of research into the relative ages of these implements. The yellow iron staining is believed to have been produced by the deposition of iron solutions on the flint during burial beneath the soil or dune material for a period long enough to permit the fixation of the covering material by vegetation and the production in it of iron-bearing solutions resulting from the decay of vegetable matter. Conversely, the noticeable absence of any colouring matter to relieve the whiteness of the alteration product characteristic of the coastal and recent inland dunes is believed to be due to the almost total absence of iron solutions in the soil and dunes, so that burial under those conditions would not produce the appearance characteristic of burial on the more inland camp sites. Laboratory and field experiments are being carried out and others are contemplated in an attempt towards a solution of these problems, the solution of which would assist materially in establishing the relative ages of some types of implements.

Within the area examined, Tertiary limestones, approximately of Miocene Age, outcrop and form the basement on which the various dunes have been deposited. These Tertiary limestones, however, appear to have a gentle dip in a northerly direction and disappear beneath sea level at about the latitude of Cape Banks, the most northerly outcrop along the coast occurring about one mile to the north of that cape.

The presence in the Kongorong area, at or near the surface, of this limestone, probably was a contributing if not the main factor in the production of a better soil type as compared with the area immediately to the north-west, composed largely of wave or wind-sorted material, and in which soil deficiencies have been troublesome.

It is to these Tertiary limestones and their erosion and distintegration chiefly by wave action that the region owes its supplies of flint, which are practically the only material used by the aborigines in the production of stone artefacts. Certain horizons in the limestone series contain flint nodules and boulders in very large quantities. Such occurrences are plentiful along the coastline between Cape Banks and Douglas Point and are particularly well exposed at Black Point. At Cape Buffon accumulations of flint pebbles appear to be derived from limestone reefs below sea level but probably not far from the shore.

The flints vary considerably in shape, colour, size and texture, and it is obvious that a very large proportion would have been unsuitable for implement manufacture by the natives. The successful selection of a flint pebble suitable for such a purpose would require a considerable degree of skill and knowledge and of intelligence. Flint pebbles sufficiently large and uniform in texture for the production of the large hand axe referred to earlier were found to be exceedingly scarce.

While the flints may exhibit a great variety of colours and shades, the predominant colours range from dark grey to bluish-black.

The banks of flints occurring at high water mark and accumulated there by wave action along this section of the coastline and beyond were the chief source of supply for the natives. Other sources appear to have been the deposits left as remnants of former shorelines now miles inland. A number of these have been located on the coastal side of the Woakwine Range (e.g. Narrow Neck) and elsewhere, and many others exist without a doubt in the scrub at the foot of the Woakwine Range.

The practical certainty in this district that a bare spot on a hillside will prove to be a windblown area carrying at least some evidences of former native occupation, such as hearths, flint chippings, etc., coupled with the knowledge that conditions created by European occupation have favoured wind erosion, makes it difficult to believe that all these blown areas existed as such when the white man arrived. No doubt this was true of many areas, but it is logical to be doubtful of the recent occupation of all of them, especially as active erosion is still proceeding and extending the areas. Such instances are the Belt Site, Wk. 5, KR. 5, etc.

In the Bevilaqua's Ford area, wind erosion and sand drift are so active that it is evident that camp sites examined in any one year may well be buried next year and others be exposed. It is probable that removal of the surface cover almost anywhere in the dune ridges and ranges would expose evidence of former native occupation, particularly in those parts which are situated favourably with respect to shelter, food, and water supply.

The Belt Site, notable for its richness and variety of artefacts, is an instance where active wind erosion is bringing to view parts of a former camp site and exposing artefacts covered by dune sand. The richness of this and some other areas can be attributed partly to the fact that the removal by wind action of the sand has concentrated on a hard floor the whole of the artefacts which previously were dispersed in the material vertically above it. This process of concentration, particularly on sandhill camp sites, of the whole of the material originally contained in a dune, on a hard floor and the possible mingling with relics of a different age complicate the study of implements from the point of view of their age relationships compared with the easier problem involved, for example, in the excavation of stratified levels on the floors of caves and rock shelters. Such problems, however, might be simplified if further research confirms the belief that the type and degree of alteration of the flints is a criterion that can be applied to the determination of their relative ages.

PART III.

REVIEW OF THE FOOD SUPPLY OF THE NATIVES.

Consideration of the various possible sources of food shows clearly that the staple diet of the natives must have consisted of marsupials—kangaroos, wallabies, possums, wombats, and short-nosed bandicoots; and of birds such as emus, bustards (Native Turkeys), Native Companions (Australian Cranes), ducks, swans, and probably moor-hens and swamp-hens.

In the spring months the eggs of these birds and others would probably have formed an important part of the diet.

In the summer months of the year weather conditions would allow for securing abundant supplies of the large salt-water crayfish, the various shellfish mentioned

later on, and seafish that could be speared or otherwise secured. Depending also upon weather conditions would be the gathering of large numbers of the little "mucilaginous" fishes obtained by making weirs across the flooded swamps.

Reptiles can have furnished only occasional tit-bits.

Insects would be represented by sometimes obtaining the large grubs found in the red gums and banksias.

The supply of plant foods was almost negligible, consisting of a few small fruits, the best of which were the muntries and the small white berries of *Leucopogon*. A few bulbous roots were obtained, and on Mrs. Smith's authority, some seeds were also available. These vegetable sources of food would give a little variety, but were seasonable and mostly in small quantity.

From the above summary it will be seen how dependent the natives must have been upon the marsupials and larger birds. Professor Mitchell informs us that we can probably estimate the food required to maintain a man, his wife, and two children in health without deteriorating at about 65 pounds of meat food per week, if meat alone were available, which would be approximately the equivalent of one kangaroo or one emu or four wallabies (allowing for bones, etc.). Though opossums may show plenty of retroperitoneal fat and even subcutaneous fat and according to the availability of feed, wallabies and kangaroos may have considerable quantities of fat round the kidneys, it is probable that the latter animals were on the whole rather deficient in fat, which was in consequence a food much sought after. As the fur is burnt off before cooking, the skin was probably consumed. The natives made use of all available portions of the animals, eating all the viscera, including the intestines (after expelling their contents). Their method of cooking the intact animal retained all the body juices. As elsewhere, the long bones would be broken for their marrow content rich in fat.

EARLY ACCOUNTS OF THE APPEARANCE OF THE NATIVES AND OF THE ABUNDANCE OF GAME. When in April, 1844, Sir George Grey's party lighted fires on the top of Mount Benson, S.E. of Lacepede Bay, these fires were soon answered by many columns of smoke to the south and east, and finally all around "giving indications of a larger population amongst these banksia woods than we anticipated." Further on, after having met them, G. French Angas notes that "these natives belonged to a tribe totally different from those of the Milmendura, whom we had met with along the shores of the Coorong, and were very inferior to them in physical appearance.... Their figures (were) extremely slight and attenuated, with the abdomen of a disproportionate size. They were filthy and wretched in the extreme; all their teeth were black and rotten, their skin was dry, and that of one man presented a purplish-red colour." It thus appears that in the Mt. Benson-Rivoli Bay district there was a considerable population, but the people looked attenuated with protuberant abdomens and decayed teeth—the last a very surprising statement if really based on a careful examination. The following account of the foods available to these people will show that in quantity it was seemingly ample. As this district is subject to "coast disease" in sheep (due to a deficiency in copper and cobalt), is there any possibility, since the natives necessarily lived entirely "off the land," that the same or some similar deficiency was the explanation of their appearance?

Ebenezer Ward, when he visited the South-East in 1869 noted the abundance of game near Mt. Muirhead (p. 68). "In its vicinity I scarcely ever passed it without seeing a flock of emus, or a mob of kangaroos, or both, on some part of it; and the ferns, which are dense and luxuriant everywhere on the lower and sandier slopes of the range extending from Mt. Graham and Mt. Burr, fairly swarm with marsupials. From the diminutive 'brush', not much bigger than a

buck rabbit, to the lordly 'old man', squatting six feet high on his hams and tail, the brutes live, increase and flourish. On the flats wild turkeys are plentiful, and on the lagoons on the timbered flats stretching northward from the foot of Mt. Graham wild duck, teal, geese, and swan abound at certain seasons of the year."

DETAILED ACCOUNT OF THE ANIMAL FOODS AVAILABLE.

MAMMALS.

CANNIBALISM. As with natives in other parts of Australia, the Buandik aborigines sometimes practised cannibalism.

Unpublished manuscript notes of the late Duncan Stewart contain the statement that infants, when disposed of, were "sometimes eaten".

Stewart's mother, Mrs. James Smith, also wrote (p. 8) concerning this custom: "Many of the women ate their offspring; they said it was a part of their flesh and made them strong."

MARSUPIALS AND MONOTREMES. The natives of the Coorong near the Narrows (G. F. Angas, p. 139) constructed "elevated seats or platforms in bushy she-oak trees for the purpose of watching and spearing the emu and kangaroo as they pass towards the water to drink".

I am indebted to Mr. H. H. Finlayson for supplying me with information as to the occurrence in the South-East of various mammals that may have served as food for the natives and as to their likely prevalence before the coming of the white man. The marsupials have been arranged, in general, in order of prevalence. The length of the head and body (L.) given in millimetres is from Wood Jones' *Mammals of South Australia* and indicates the sizes of the animals. Some approximate weights (W.) were supplied by Mr. D. Schulz of Rendlesham and others are from Brough Smyth's *The Aborigines of Victoria*. The native names given here and elsewhere are from Mrs. James Smith's vocabulary.

Gray Kangaroo (*Macropus giganteus*). Koora, Koor-aa, a male "forrester" kangaroo; Mare-e, a female "forrester" kangaroo (Mrs. Smith). L. 1500 mm., W. 100 lb. (Schulz); 150 lb. (Brough Smyth).

In the unpublished manuscript on the Buandik by the late Duncan Stewart, the following note appears: "In the year 1846, kangaroos were not by any account plentiful; although some twenty-five years later they became so numerous that the Government and the settlers had to employ men to destroy them, as they were devouring nearly all the feed. They became almost as much a plague as rabbits are at the present time. The dying out of the natives might, to some degree, account for the increase of the marsupials. Some fifty thousand were destroyed in five years."

Ebenezer Ward, writing in 1869, referred (p. 12) to the kangaroo nuisance as having acquired "the most astonishing and serious proportions" from the pastoralists' point of view. The owners of two Mount Benson runs had paid the natives for 30,000 head at 6d. each. He himself had on one occasion seen a mob "that could only be counted by thousands." This great prevalence of kangaroos seems to have been in general attributed to the disappearance of the natives who, previously to the disturbing effect on aboriginal life of the white usurpation, had kept the numbers in check.

The *Cyclopedia of South Australia*, published in 1909, referring to the Mt. Gambier district (Vol. II, p. 954) says that:

"When white men appeared on the scene, there was vegetation everywhere, or else bracken and scrub and interminable forests of eucalypti. Fifty years ago kangaroos swarmed all over the country, sometimes herds of hundreds together. The pastoralists voted them a nuisance, drives were organized, and as many as two thousand were killed in a single battle."

According to Mr. D. Schulz's informants, women and the men used to drive kangaroos and emus along the narrow strip of land between Lake George and the sea (near Beachport) and the younger men would wait in ambush to spear the game as it came along the constricted area. (This feature of "strategic" locations has already been described in several of the camp sites mentioned in Part I).

Pit Traps. Another example obtained by Mr. Schulz of trapping animals by organized drives was the method adopted in the Woakwine Range about a mile east of Woakwine Station. There a large pit was excavated at the end of a gully (the pit, Mr. Schulz states, is still to be seen) and hidden by brushwood. Kangaroos were driven off the flats and manoeuvred towards the gully and the hidden pit trap. Often several beasts were secured in this manner.

Red-necked Wallaby, Brusher (*Wallabia rufogriseus*). L. 952–1,050 mm., about 30 lb. (Schulz), prevalent.

Toolach Wallaby, Grey's Wallaby (*Wallabia greyi*). L. 810–840 mm., probably common.

Rufous-bellied Wallaby (*Thylogale billardieri*). L. 525–650 mm., prevalent.

Black-tailed Wallaby (*W. bicolor*). L. 820 mm., rare.

Common Australian Wombat (*Phascolomys mitchelli*). Moo-raa. W. up to 70 lb. (Brough Smyth); av. 40 lb. (Schulz), prevalent.

G. French Angas (p. 63) says: "At the upper end of the Coorong the natives caught wombats by stopping up all the entrances to their burrows and lighting a fire of greenwood at the aperture, thus suffocating the animals." He gives (p. 132) Mr. Bonney's discription of how the Lake Albert tribe dig the wombat from its burrow, by making a shaft about ten feet deep and then cook it whole between hot stones in sand. They gave him some roast wombat to eat which tasted likd young pork and was very palatable. Near Rivoli Bay (p. 156) Angas saw two large wombats roasting in the native ovens.

Common Native Cat (*Dasyurus viverrimus*). Kee. L. 285–457 mm., prevalent.

Tiger Cat, Spotted-tailed Native Cat (*D. maculatus*). L. 610 mm., sparse.

Short-nosed Bandicoot (*Isoodon obesulus*). L. 340 mm., prevalent.

South Australian Barred Bandicoot (*Perameles myosura*). L. 240 mm., sparse.

Common Opossum (*Trichosurus vulpecula*). Koor-amo. L. 455 mm., about 4 lb. (Schulz), prevalent.

South Australian Ring-tailed Opossum (*Pseudochirus laniginosus*). L. 300–360 mm., about 1½ lb. (Schulz), prevalent.

Koala, Native Bear (*Phascolarctus cinereus*). L. 750–810 mm., W. about 40 lb. (Brough Smyth), rare.

Lesuer's Rat-Kangaroo (*Bettongia lesueri*). L. 370–457 mm., sparse.

Tufted-tailed Rat-Kangaroo, Squeaker (*B. penicillata*). L. 390 mm., sparse.

Potoroo or Common Rat-Kangaroo (*Potorus tridactylus*). L. 320–410 mm., sparse.

Hare Wallaby (*Lagorchestes leporoides*). L. 450–490 mm., sparse.

Spiny Ant-eater (*Echidna aculeata*). Sparse.

CETACEA (Whales, Dolphins). Kunt-ar-bool, a whale.

Whales and dolphins were occasionally washed up on the shore and unquestionably proved an ample source of food, probably until decomposition was far

advanced or the whole animal was consumed. The late Duncan Stewart in his unpublished manuscript, mentions that "a dead whale cast ashore occasionally provided them with a feast."

Whale feasts. From information collected by Mr. D. Schulz the natives round Rivoli Bay were always hungry, excepting when a whale came ashore. Smoke signals would be sent up and natives from near and far would come and be allowed to join in the feasting. For visiting natives, "safe conduct" was permitted during these special feasting occasions.

Sir George Grey gives an amusing account of how the Western Australian natives filled themselves to depletion, slept and fed again, meanwhile rubbing the fat over their bodies, until the carcase was consumed. Brough Smyth says that *Physalus grayi* McCoy (= *Balaenoptera physalus*) was the species commonly stranded in Victoria and eaten by the natives and that they also ate the dolphin *Delphinus delphis.*

Fifteen species of *Cetacea* have been recorded from South Australian coasts and it is likely that from time to time stranded whales, porpoises and dolphins were eaten in the South-East.

RODENTS. Mr. H. H. Finlayson states that the following rats were present in the South-East and doubtless contributed to some extent to the food supply of the natives.

Australian Water Rat (*Hydromys chrysogaster*). L. 200–390 mm.
Allied Rat (*Rattus assimilis*). L. 181 mm.
Dusky-footed Rat (*R. lutreola*). L. 176 mm.
Tawny Rat (*R. vellerosus*). L. 190 mm. Between Murray and Glenelg Rivers.
Sir George Grey's Rat (*R. greyi*). L. 152–186 mm. One was disturbed in dense undergrowth during our visit and secured.
Long-eared Rat (*Pseudomys auritus*). L. 130 mm. L. Albert.
Gould's Rat (*P. gouldi*). L. 119 mm. Coorong.
Mastacomys sp. Remains in guano cave at Mt. Gambier noted by Wood Jones.
White-footed Rabbit-rat (*Conilurus albipes*). From N.S.W. and Victoria into South Australia.

CARNIVORA. DINGO (*Canis familiaris dingo*). Kar-na-chum.

PINNIPEDIA. Seals, etc. Moo-a, a seal.

South Australian Sea Lion (*Arctocephalus cinereus*), Bass Strait to W.A. Large bull more than 10 feet. Sparse.
Australian Furred Seal (*A. doriferus*). Males 6 feet, females 5 feet.
Weddell's Seal (*Leptonychotis weddelii*), 9 feet (900 lb.). Straggler at Encounter Bay.
The Sea-Leopard (*Hydrarga leptonyx*) has been found as a wanderer in South Australian waters.

BATS. The South Australian bats from their small size need not be considered as an article of food except perhaps as an occasional tit-bit. The large fruit-eating bat of the eastern States, commonly known as the Flying Fox, has been found as a stray at the west end of Kangaroo Island, and in other parts of this State.

BIRDS.

In the Millicent district 114 species of birds at least are known to breed (A. E. Ey, *S.A. Ornithol.* 17, 4, Dec. 1944, pp. 32–37). Probably any of these birds would be eaten if the natives happened to secure them, though it might be questioned whether they would go out of their way to capture such birds as the

Little Penguin or Cormorants. I have myself eaten the Australian Pelican (*Pelicanus conspicillatus*—it does not breed in the district) and found its dark meat good. Angas (p. 156) near Rivoli Bay noted a fine parrot, not yet cooked, suspended to a stick. Even the smallest birds if accidentally caught or knocked over might be loosely plucked and put on the embers and eaten as a *bon bouche*, especially by the children. Without exception, the eggs of all birds would be eaten and young birds in the egg would not be discarded.

Snares for Birds. G. French Angas (p. 148) says, "At Ross's Creek near Lacepede Bay, we began to find various indications of natives; the most remarkable being wickerwork snares for bird-catching, about four feet high, erected on the flats. Near these snares were formed small covered places, just large enough for one person to squat in; the native, concealing himself in this ambush, with his snaring rod protruded from a small aperture in the side, imitates the voice of the birds, and, as they alight upon the wicker work, dexterously slips the noose around their necks, and snares them into his retreat."

Method of Catching Ducks. Mrs. James Smith in *The Booandik Tribe* (p. 41) gives the following description of how the natives killed ducks. "Each native made up a bundle of sticks and disappeared in the dark, among the bushes, to the lagoons (Orumbel swamp), where the ducks had 'turned in' for the night. The drual (men) made a great noise; and as the game rose on the wing, the hunters threw the sticks at them and brought them down." Mrs. Smith was given a waddy to kill them when down.

The following list comprises the larger birds and eggs which are likely to have contributed definitely to the food supply; the eggs, however, only from late winter to midsummer. The number of eggs in the clutches are also given and the weights of the eggs when known. The native names are from Mrs. Smith's account.

Tuman tuman, birds.

Emu (*Dromaius novae-hollandiae*), Kower or kowber. W. 130 lb. (Brough Smyth). Usually 7 to 12 eggs, occasionally 16. Average weight of eggs 22½ oz. (weight of shell, 3 oz.).

Little Penguin (*Eudyptula minor*), Moo-nera. Perhaps eaten occasionally when washed ashore. Eggs and young would be eaten when accessible.

Stubble Quail (*Coturnix pectoralis*). Birm-birm, meadow quail. Pea-na-wir-ter, the high ground quail (Penewurter, brim-brim. Quails). Common, 7 eggs.

Common Bronzewing (*Phaps chalcoptera*). Koo-ren, a pigeon, 2 eggs.

Brush Bronzewing (*P. elegans*). Still very common; 2 eggs.

Lewin Water-rail (*Rallus pectoralis*), 4 eggs.

Banded Land-rail (*Hypotaenidia philippensis*). W. 125 grms. (S.A. Museum). 6 eggs.

Dusky Moorhen (*Gallinula tenebrosa*). Keil, a water hen, coot. Common, 11 eggs.

Eastern Swamp-hen (*Porphyrio melanotus*). Common. 5 to 7 eggs.

Black Cormorant (*Phalacrocorax carbo*). Minam-minam, a shag, Kro-an-dum, a cormorant. Nest on the islands. 3 to 5 eggs.

Pied Cormorant (*Ph. varius*). Nest on the islands. 2 to 4 eggs.

Little Pied Cormorant (*Microcarbo melanoleucus*). 4 to 5 eggs.

Australian Pelican (*Pelecanus conspicillatus*). Par-ang-all. 2 to 3 eggs.

Crested Tern (*Sterna bergi*). Common. Nests on the islands. W. 227 grms. 1 egg.

Silver Gull (*Larus novae-hollandiae*). Ping-ang-ool, large gulls. Tar-oo-ki, a sea gull. Common. Nests on the islands. 2 to 4 eggs, usually 3.

Pied Oyster-Catcher (*Haematopus ostralegus*). Bir-wir, the red-bill. Rare. 3 eggs.

Spurwing Plover (*Lobibyx novae-hollandiae*). Very common. 4 eggs.
Banded Plover (*Zonifer tricolor*). Very common. 4 eggs.
White-headed Stilt (*Himantopus leucocephalus*). 4 to 5 eggs.
Tat-a-a, Snipe. This native name may perhaps apply to the Australian Snipe (*Gallinago hardwicki*), the Australian Painted Snipe (*Rostratala australis*), or possibly to Stints, the Greenshank or Sandpipers or to all these in general. These birds, with the exception of the Painted Snipe, breed outside Australia. Being wary birds, the natives doubtless did not often secure them.
Southern Stone-curlew (*Burhinus magnirostris*). 2 eggs.
Australian Bustard, Plain Turkey (*Eupodotis australis*). Laa, the bustard turkey. W. 30 lb. (Brough Smyth). Usually 1 egg.
Native Companion (*Megalornis rubicundus*). Wandi. W. 25 lb. (Brough Smyth). 2 eggs.
White Ibis (*Threskiornis molucca*). Common. Nests in tea-tree on an island in L. Bonney. 2 to 3 eggs.
Strawnecked Ibis (*Threskiornis spinicollis*). Very common. 3 to 4 eggs.
Royal Spoonbill (*Platalea regia*). A few small nesting colonies. 3 to 4 eggs.
Yellow-billed Spoonbill (*P. flavipes*). Rare. 3 eggs.
White Egret (*Egretta alba*). 3 eggs.
White-faced Heron (*Notophoyx novae-hollandiae*). Ngar-a-pine, a slate-coloured crane. Common. 4 to 6 eggs.
Nankeen Night-Heron (*Nycticorax caledonicus*). 3 eggs.
Brown Bittern (*Botaurus poeciloptilus*). Pool-an. Rare. 4 to 5 eggs.
Black Swan (*Cygnus atratus*). Koo-no-war. Very common. 5 to 6 eggs, occasionally 8 or 9.
Pat-om, a magpie, a goose.
Cape Barren Goose (*Cereopsis novae-hollandiae*). 3 to occasionally 7 eggs.
Mountain Duck (*Casarca tadornoides*). 10 to 14 eggs.
Black Duck (*Anas superciliosa*). Pur-ner. Very common. 9 to 12 eggs.
Chestnut Teal (*Querquedula castanea*). Rare. 8 to 12 eggs.
Grey Teal (*Q. gibberifrons*). Very common. 8 to 12 eggs.
Blue-winged Shoveler (*Spatula rhynchotis*). W. 338 gms. 9 to 11 eggs.
Musk Duck (*Biziura lobata*). Tin-bal-ang. W. 1,007 gms. 2 to occasionally 6 eggs.
Swamp Harrier (*Circus approximans*). Very common. 4 to 5 eggs.
Australian Goshawk (*Astur fasciatus*). Very common. 3 to 4 eggs.
Wedgetail Eagle (*Uroaetus audax*). Ngee-re. 1 to 2 eggs.
Whistling Eagle (*Haliastur sphenurus*). Very common. 2 to 3 eggs.
Brown Hawk (*Falco berigora*). Very common. 3 eggs.
Nankeen Kestrel (*F. cenchroides*). Common. 3 to 4 eggs.
Boobook Owl (*Ninox boobook*). Common. 2 to 3 eggs.
Barn Owl (*Tyto alba*). Rare. 3 to 4 eggs.
Musk Lorikeet (*Glossopsitta concinna*). 2 eggs.
Red-tailed Black Cockatoo (*Calyptorhynchus banksi*). Evidently Treen, "the black cockatoo, with red feathers in the wings" [mistake for tail] must refer to this species, an interesting locality record. 1 egg.
Yellow-tailed Black Cockatoo (*C. funereus*). Wil-er, "the black cockatoo, with yellow feathers in the wings" [mistake for tail]. 2 eggs.
White Cockatoo (*Kakatoe galerita*). Mar, the white cockatoo with yellow crest. 2 eggs.
Corella (*K. tenuirostris*). Kar-a-al, a white cockatoo, presumably refers to this species as Mar clearly belongs to *K. galerita*—an interesting locality record.
[Galah (*K. roseicapilla*) has only recently reached the South-East].

Mir-an, "the cockatoo parrot with fish-coloured feathers." This is evidently the Gang-Gang Cockatoo (*Callocephalon fimbriatum*), an interesting early locality record.

Crimson Rosella (*Platycercus elegans*). 3 to 5 eggs.

Eastern Rosella (*P. eximius*). 5 to 6 eggs.

Kal-nigal, koo-a-da, parrots. Probably the above two species.

Kookaburra (*Dacelo gigas*). Koo-art-ung, a laughing jackass. 3 to 4 eggs.

Welcome Swallow (*Hirundo neoxena*). Natives at Cape Buffon, Mr. D. Schulz's relatives informed him, would spend hours patiently snaring swallows for food. This method of snaring birds with long stick and string noose at its end has been described earlier in this paper. The swallow referred to was the Welcome Swallow, which may frequent seaside cliffs and probably often nested on the sheltered walls before human habitations supplied more satisfactory nesting places.

Scarlet Robin (*Petroica multicolor*). Tat-kana, a robin redbreast. Too small to be worth eating.

Noisy Miner (*Myzantha melanocephala*). Once common, now rare. 3 to 4 eggs.

Little Wattle Bird (*Anthochaera chrysoptera*). Common. 2 eggs.

Red Wattle Bird (*A. carunculata*). Now rare. 2 eggs.

Spiny-cheeked Honeyeater (*Acanthagenys rufogularis*). Common. 2 to 3 eggs.

Australian Raven (*Corvus coronoides*). Wa. 4 to 5 eggs.

Little Crow (*C. bennetti*). 3 to 5 eggs.

Black-winged Currawong (*Strepera melanoptera*). Kil-en, a black magpie. Rare. 3 eggs.

Grey Butcher Bird (*Cracticus torquatus*). Common. Woi-ong, the Whistling Jay. 4 eggs.

White-backed Magpie (*Gymnorhina leuconota*). Toal, the magpie. 4 to 5 eggs.

REPTILES.

The Tortoise is said to be numerous in the waters near Rendelsham. The species has recently been identified, and proves to be the Long-necked Tortoise (*Chelodina longicollis*), whose weight is said to reach 9 pounds 4 ounces. A specimen, or specimens, of the Saw-toothed Tortoise (*Emydura latisternus*) was reported by A. Zeitz as occurring before 1891 in the Mt. Gambier Lakes. The Long-necked Tortoise, though it was distasteful as food to Europeans, was definitely eaten by the natives on the Murray and so presumably by those in the South-East.

Mrs. Smith gives the words Kar-im and Ngoon-ap as names evidently of different kinds of lizards which, as they possessed a name, were probably used for food.

The following list of lizards and snakes which probably occur in the South-East were large enough to serve as sources of food and so undoubtedly would have been used by the natives. At Blackfellows' Caves one of us tried the flesh of a Tiger Snake, but found very little on it. There is a small amount of flesh on each side of the backbone. The tail probably contains a considerable amount of meat, but unfortunately was not sampled. The lengths given are mostly from Waite's *Handbook of the Reptiles of South Australia*. The lengths and weights of the two Tiger Snakes and the Sleeping Lizard were obtained during our recent trip to the South-East. Information does not seem available as to whether the common goana was found in the South-East, and, if so, whether it was abundant. The Carpet Snake (*Python spilotes*) certainly did not occur.

Tree Dragon (*Amphibolurus muricatus*). 307 mm. (1 ft.)
Jew Lizard (*A. barbatus*). 530 mm. (1 ft. 8½ in.).
Lace Lizard or Common Goana (*Varanus varius*). Probably occurred. 2,100 mm. (6 ft. 10½ in.).
White's Skink (*Egernia whitii*). 355 mm. (1 ft. 2 in.).
Sleeping Lizard (*Trachysaurus rugosus*). 330 mm. (13 in.). W., 1½ lb.
Blue-Tongue (*Tiliqua scincoides*). 585 mm. (1 ft. 11 in.).
Southern Blue-Tongue (*T. nigrolutea*). 395 mm. (1 ft. 3½ in.).
Brown Snake (*Demansia textilis*). 1,830 mm. (6 ft.).
Black Snake (*Pseudechis porphyriacus*). 1,980 mm. (6 ft. 6 in.).
Copper-head (*Denisonia superba*). 1,676 mm. (5 ft. 6 in.).
Tiger Snake (*Notechis scutatus*). 1,830 mm. (6 ft.). One killed near C. Banks. 4 ft. 6 in. long, weighed just under 1¾ lb.; another 3 ft. long, 1½ lb.

Fish.

Mr. P. Jackway, an expert fisherman at Blackfellows' Caves, supplied in answer to our inquiries the following information as to what fish could be speared by the natives on the reefs or in shallow water, or could be caught in nets or otherwise from the shore. The lengths and weights given are his and are probably only approximate, but they indicate whether the fish concerned was likely to supply a good deal of food. One of the most common of the fishes probably was the eel, which doubtless could be secured in considerable numbers when they were making for the sea after the first heavy rains.

Fishes that could be speared from the Reefs, etc.:

Sharks—Noon-kolar, a shark.
Gummy (*Mustelus antarcticus*), L. 2 to 3½ ft.
Blue Pointer or Snapper (*Isurus glaucus*), L. to 15 ft.
Big Ground Shark (very easy to get) (species ?). L. 10 to 18 ft.
Carpet Shark (*Orectolobus*) (very easy to get), L. 4 to 9 ft.
Skates and Rays. Mr. Jackway recognized two kinds of Skate, one black and shiny, the other grey, and three kinds of Sting-ray, black, brown and grey, one to the length of 14 ft. with eyes 2 feet apart!
Skate (*Raja australis*).
Sting-ray (*Dasybatis brevicaudatus*). Marma, sting-ray.
Fresh water (Long-finned) Eel (*Anguilla reinhardtii*), L. 15 in. to 3 ft. 3 in. to 3 ft. 6 in. These now come down the drainage creeks after the first heavy rains and doubtless in the early days passed down to the sea-outlet of Lake Bonney and other natural outlets to the sea.
Conger Eel (*Conger wilsoni*), a very big one weighed 37 lb.
Rock Cod (*Physiculus barbatus*), W. ½ to 2 lb.
Slimy Cod (species ?). W. ½ to 2 lb.
Butterfish (*Sciaena antarctica*), W. 2 to rarely 12 lb.
Flounder (*Rhombosolea flesoides*), W. to 2 lb.

Caught in nets if used on the shore:

Garfish (*Hyporhamphus intermedius*), W. to 1¼ lb. (rarely).
Kok-ber, the mullet (*Mugil argenteus*), W. ½ to 2 lb.
Pike (Snook) (*Sphyraena novae-hollandiae*), W. 1 to 5 lb.
Whiting (*Sillaginodes punctatus*), W. ½ to 2½ lb.
Tommy Rough (*Arripis georgianus*), W. ½ lb.

Salmon Trout (*Arripis trutta*), W. ½ lb.
Jack Salmon (*Arripis trutta*), W. 1 to 8 lb.
Snapper (*Pagrosomus auratus*), W. ½ to 17 lb., av. 8 to 9 lb.

The fresh-water fish, excepting the eels, are mostly small. Some evidently formed an important article of diet at certain times. Thus G. French Angas near Rivoli Bay on May 2, 1844 (p. 155), came on some swamps where "the natives had built weirs of mud, like a dam wall, extending across from side to side, for the purpose of taking very small mucilaginous fishes that abound in the water when these swamps are flooded". Mr. H. M. Hale first thought that these mucilaginous fishes were probably lampreys. This seems unlikely as the records of when lampreys have been taken in fresh-water streams in South Australia do not include the month of May. Later (p. 174) near Lake Frome, Angas's party came upon a camp of the natives, where on "one fire were frying a quantity of very small mucilaginous fishes, which the natives catch in weirs upon the swamps and in the shallow waters of Lake Frome".

Fishes, Mr. D. Schulz's notes state, were sometimes caught in the fresh-water swamps by building mud banks to form "traps" into which the fish were driven. This has also been mentioned by Angas.

The Rev. J. E. Tenison Woods in *Geological Observations in South Australia* 1862 (p. 50) mentions small fish called "Lap-lap," never more than 2 inches long that the natives seem to be fond of.

In order to ascertain to what species the small mucilaginous fishes might belong, Mr. D. Schulz, of Rendlesham, kindly collected examples of the fresh-water fishes from the drain at Narrow Neck, near Rendlesham, and these comprised the following species. The weights of the examples are given.

Cherax destructor Clark (17 grms. and 11 grms.).
Pseudaphritis urvillii (190 grms.).
Gadopsis marmoratus (45 grms.).
Galaxias attenuatus (12 grms.).
Nannoperca australis (1 grm.).

CRUSTACEANS.

The large Salt-water Crayfish (*Jasus lalandii*) can be obtained in great abundance under the ledges of rocks on the reefs of this coastline. It must have formed an important and easily procurable source of food. The ease with which the exoskeleton can disintegrate may explain why none of these was ever noticed on the old camp sites. Mrs. Smith gives the names Kell-r and Ngum-ato for the Salt-water Crayfish. The lengths and weights of some of the Salt-water Crayfish obtained during our stay were as follows: 8½ in. (9 oz.), 10 in. (1 lb.), 15 in. (7 lb.); we were informed that one had been obtained which weighed 9 lb.

The Yabbie or Fresh-water Crayfish (*Parachaeraps bicarinatus*) was known as Konkro, according to Mrs. Smith. A specimen taken in the Torrens gave a live weight of 14·7 grms. and was 80 mm. (more than 3 in.) from tip of snout to tip of tail.

A large crab collected during our stay proved to be *Plagusia chabrus* which occurs on all the exposed coasts of South Australia and is known to be palatable as food. The Sand Crab (*Ovalipes bipustulatus*) and the big Reef Crab (*Ozius truncatus*) probably occur. The big Blue Crab (*Portunus pelagicus*) has not been recorded. The Shrimps (*Leander serenus* and *L. intermedius*) would be found in pools amongst rocks.

INSECTS.

The Red Gum Ghost Moth (*Trictena argentata*). According to an article in *Wild Life* (Vol. 6, No. 3, p. 90, 1944), natives used both the grubs and the adult moths of this insect. The moths at night were attracted by the light and fell into the fire and there were partly roasted. G. French Angas in describing the natives of South Australia (p. 83) says that "they are especially fond of the caterpillar of a large species of moth; which, like the *Cossus* of the Romans, is regarded as a delicacy: it is a fleshy grub, of a cream colour, about three or four in. long, and is found in the decaying wood of the *Eucalyptus*. The natives are very expert in discovering the retreats of these insects, and draw them out by inserting into their holes a thin twig, at the end of which a wooden hook is attached; this instrument is worn behind the ear of the men, and is called *pileyah*, or *pirri*".

The Banksia Longicorn (*Mnemopulis edulis*). The fat cream larva of this brown longicorn beetle found in the wood of *Banksia marginata* was a favourite food of the blacks, according to an article in *Wild Life*, Vol. 6, No. 1, 1944, p. 6.

Both of these trees grow in the South-East, the Banksia over the whole of the district of the Buandik Tribe, but the Red Gums in the flat country of the eastern part of the range of the tribe.

Aquatic Beetles. G. French Angas notes that at a native campfire near Lake Frome the natives had been roasting aquatic beetles which he says, "here formed an article of food amongst these miserable creatures".

Eggs of ants. Mrs. Smith says that *Purter* was the name given to a white ant's egg (really larva). The use of a native name for this white ant larva suggests that it was eaten.

The native stingless bee does not occur in this region, so honeycomb was not available.

The Sugar-lerp Insect, *Spondylaspis eucalypti*. The sweet waxy secretion of this insect belonging to the *Psyllidae* was collected and eaten by the natives probably wherever it occurred. The Manna Gum, *Eucalyptus viminalis*, derives its vernacular name from its being a host of the Sugar-lerp insect. Both this eucalypt and the insect occur in the South-East.

MOLLUSCA (Shell-Fish).

On the camp sites near the coast of Cape Buffon and from Cape Banks to nine miles south-east the shells of *Turbo undulatus* Solander are very abundant. As it is now nearly a hundred years since aboriginals are likely to have used these for food, it is clear that the shells that are now to be found may represent the accumulations over a period of many years at one particular level. Moreover, as drifting sand may bury the shells, superimposed layers may have existed and then the shells of the different ages may have been brought together later when the sand blew away. However, at any one midden, the shells seemed uniformly weathered in appearance. These shells have portion of the outer lip broken away to such an extent as might have exposed the retracted operculum after the shell had been cooked in hot ashes. Many shells have a large window knocked in the largest whorl. Some shells are practically quite intact, and shell fragments also exist. Mr. B. C. Cotton is of the opinion that the large windows are such as might occur if the shells had been dropped on a hard surface or alternatively hit by a stone. He suggests that the natives in extracting a shell-fish for food would probably break the shell into fragments and pick the cooked fish out of these. It seems quite likely that some of the fine stone points collected in abundance on these camp sites may have been used by the natives to extract the cooked shellfish

either after breaking the rim or by making the window. The Turbo shells in some places preponderatingly showed the window and in other places the breaking of the outer lip. Both may coexist. The shells seem now not to be present in great numbers on the reefs, though living specimens can probably be easily secured. It seems doubtful whether they could have formed an important item in the food supply of the natives if the shells were no more abundant in their day than now. It has been suggested that the natives feeding upon these may have led to a great depletion in their numbers which has persisted to the present day.

Next to the Turbos, probably the most abundant shells were our common true Limpet *Cellana tramoserica* Sowerby and the coarsely-ribbed limpet-like *Patelloida alticostata* Angas, both of which shells are still common on the rocks, while on some camp sites near long sandy shorelines, bivalves were prominent, especially *Plebidonax deltoides*. A few shells were found of *Fasciolaria australasia* Perry with large windows on the convexity. A few shells were also noticed of *Neothais textiliosa* Lamarck without windows having been made in them.

The little black *Nerita melanotragus* Smith was found occasionally in heaps, sometimes with marks of fire, the shells being mostly broken in two. Only two or three Oyster shells *Ostrea sinuata* Lamarck (= *O. angasi*) were found. There were a few small mussel shells (*Brachyodontes erosus* Lamarck). Near Blackfellows' Caves a few nacreous common sand cockles *Katelysia scalarina* Lamarck were found. These were under a layer of more sandy soil in which were embedded a few fresh-water shells (*Bullinus?*). This layer was several feet thick, the upper surface forming the platform which was on a level with the kitchen middens containing the Turbos.

Near Cape Banks particularly, a number of large mutton-fish shells were found amongst the Turbos. These belong to two species, *Schismotes laevigata* Donovan (= *H. albicans* Quoy and Gaimard), a smooth-surfaced shell up to 8 in. in length by 6 in. and with an animal weight of 8 oz., and *Notohaliotis conicopora* Peron, with raised bars on the outside and up to 5 in. in length by 4 in. and an estimated weight of the contained animal of 4 oz.

These Mutton-fish shells were mostly intact, and presumably from their numbers the living animals were collected for food. Unless taken by surprise, the mutton-fish shell adheres with remarkable tenacity to its attachment and would require a great force to remove it. If taken unawares, it can be prised off by a suitable implement of blade-like form. Stones of the required thinness and shape to do this would be difficult to find and would probably break. Ordinary sticks would be unsuitable and not strong enough. An implement like a digging stick of hard wood with a bevelled end hardened in the fire might be successful—by analogy with the Mulga (*Acacia aneura*) digging sticks of the interior, the wood of an acacia such as the Blackwood (*Acacia melanoxylon*) or the Golden Wattle (*Acacia pycnantha*) or perhaps *Acacia decurrens* might have been strong enough for the purpose.

G. French Angas states (p. 162) that *Haliotis* shells were used for carrying water—presumably this would be the smooth-shelled species, as the other species has natural orifices in the shell. He saw quantities of limpets and these large *Haliotis* shells in 1844 around native wells near Rivoli Bay.

It was noted that on camp sites near the top end of Lake Bonney, which is near a long stretch of sandy coastline, shell remains were almost exclusively bivalves, especially *Plebidonax deltoides* (including some extremely large examples), with an absence of gastropod remains which are so numerous on sites near the rocky parts of the coastline. These bivalves are also found at the Bevilaqua's Ford site.

As Mrs. Smith gives a native name, kol-ong-kel, for the octopus, probably cephalopods such as octopi and squids were eaten when they were secured.

ECHINODERMATA (Sea Eggs).

It is possible that Sea Eggs contributed occasionally to the diet of the natives. The relatively small species *Amblypneustes pallidus* Lamarck seems frequently washed ashore—its diameter is about one to one and a half inches. Mr. B. C. Cotton considers that *A. grandis* Clark, which is larger, may also occur there.

Heliocidaris armigera Agassiz also probably occurs in the South-East. It approximates to the European edible urchin, and Mr. Cotton informs me is eaten in great numbers by Pacific gulls.

I am indebted to Mr. B. C. Cotton for the following list of Mollusca and Echinodermata that are likely to have been available as sources of food in the South-East of South Australia.

PELECYPODA:

Any large bivalves.
Pinna dolabrata Lamarck—Razor Fish.
Ostrea sinuata Lamarck—Port Lincoln Oyster.
Hyridella australis Lamarck—Fresh water mussel.
Notovola alba Tate—Scollop.
Equichlamys bifrons Lamarck—Common Scollop.
Mytilus planulatus Lamarck—Large "Port Melbourne" Mussel (not plentiful in South Australia).
Modiolus albicostus Lamarck—Common Mussel.
Modiolus areolatus Gould—Common Hairy Mussel.
Brachyodontes erosus Lamarck—Common Ribbed Mussel.
Laternula recta Reeve—Soft Clam.
Eucrassatella verconis Iredale—Giant Cockle (used also as scraper and chopper).
Cardium racketti Donovan—Heart Cockle.
Katelysia scalarina Lamarck—Sand Cockle.
Katelysia peroni Lamarck—Mud Cockle.
Plebidonax deltoides Lamarck—Goolwa Cockle.
Mactra pura Deshayes—White Cockle.
Mactra australis Lamarck—Southern Cockle.
Mactra rufescens Lamarck—Rufous Cockle.

GASTROPODA. Wa-port, Mutton Fish, Shell-fish.

Marinauris emmae Reeve—Mutton Fish.
Schismotes laevigata Donovan—Mutton Fish.
Notohaliotis improbula Iredale—Mutton Fish.
Notohaliotis conicopora Peron—Mutton Fish.
Exohaliotis cyclobates Peron—Mutton Fish.
Cellana tramoserica Sowerby—Common Limpet.
Subninella undulatus Solander—Common Warrener.
Ninella torquatus Gmelin—Large Warrener.
Nerita melanotragus Smith—Black Crow.
Notopala hanleyi Frauenfeld—Freshwater Snail.
Uber conicum Lamarck——Sand Snail.
Neothais textiliosa Lamarck—Dog Whelk.
Austrosipho grandis Gray—Large Whelk.
Fasciolaria australasia Perry—Common Whelk.

ECHINODERMATA:

Adeloidaris tubaria Lamarck—Rough Spined Urchin.
Amblypneustes pallidus Lamarck—Pale Urchin.
Amblypneustes ovum Lamarck—Small Urchin.
Heliocidaris armigera Agassiz—Common Large Urchin (very like edible European in size and shape).

THE VEGETABLE FOODS OF THE ABORIGINES.

The extensive drainage system and subsequent pastoral and agricultural activities have markedly affected the indigenous vegetation; but even present-day observation reveals various sources of possible food supplies which the aboriginal no doubt utilized. These species are, of course, now restricted more to the scarcely used range and coastal strips of the country.

The following list comprises food plnats recorded as being present during our recent observations together with reference to their use in the literature. It will be seen that the foods of vegetable origin are few in number and, with some exceptions, not abundant. The only really abundant vegetable foods were the pigface fruits, muntries, native "currants", and the roots of the bulrush.

FRUITS: Mistletoe berries were probably all edible. Three species were noted, namely *Loranthus pendulus,* growing on Stringy-bark (*Eucalyptus obliqua*) on the ranges; *L. preissii,* growing on Blackwood (*Acacia melanoxylon*); and *Phrygilanthus eucalyptifolius* growing on Stringy-bark, Blackwood and Native Cherry (*Exocarpus cupressiformis*). The fleshy pedicels of the fruits of the Native Cherry are themselves edible but so small as to seem scarcely worth eating. The trees are not now very abundant. This is presumably the "tar-ang, a cherry" of Mrs. Smith.

Pig-face, the "Hottentot Fig" of G. F. Angas, a Mesembryanthemum (*Carpobrotus aequilaterus*)—keeng-a, pigface (a plant)—probably is the native fig referred to by Mrs. James Smith (p. 43) when she notes that in 1846 a young man from MacFarlane's Station, Mount McIntyre, walking to Guichen Bay was helped by a native who, "guided him to the natives' track, which was easier walking than through the scrub", and "gathered native figs for him when the damper was finished".

Nitre-bush (*Nitraria schoberi*) sometimes called native plum. Black records this species for the South-East but we did not come across it. Its fruits are edible and as G. French Angas says (p. 56), referring to it on the Lower Murray, "it has a flavour partaking at once of salt, acid, and sugar".

Muntries (*Kunzea pomifera*). Munter, a kind of native apple growing on the sea-coast. These grow near the coast on sandy soil, the branches being prostrate; they sometimes cover several square yards of ground. The small fruits are abundant and have an apple-like taste and texture. Mr. Schultz says the fruits are ripe during February, March and April. G. French Angas (p. 65) mentions that the natives of the Coorong disperse themselves over the sand-hills in search of the "monterries", returning in the evening, with their baskets filled, to the camp. This shows that the source of food supply was abundant while it lasted.

Native "Currants" (*Leucopogon parviflorus*). Ngoor-le, the white currant bush. These bushes are abundant on the coastal sand-hills of the Woakwines and the Belt from February to the end of April. They have abundant small, white, currant-like fruits and must have supplied quite a considerable amount of food when available, though there seems no reference to them in literature.

Fruits of *Astroloma humifusum,* a prostrate Epacrid, sometimes called "Native Cranberry" were doubtless eaten.

Kangaroo Apple (*Solanum aviculare*). Me-a-kec, the kangaroo apple bush. Baron von Mueller according to Bentham (*Flora Australiensis,* IV, p. 447), stated that the berry is ovoid, yellow and inedible but that *S. vescum* (Bentham puts it under *S. aviculare*) has edible globular greenish berries. Bentham says that in New Zealand *S. aviculare* has yellow ovoid edible berries. There seems to be some doubt as to whether this species which is abundant was eaten in the South-East, though a native name for it is suggestive. It fruits from January to the end of May.

Bittersweet (*S. nigrum*). This species is considered an indigenous one and possibly its small fruits were eaten.

Native Elder (*Sambucus gaudichaudiana*). The berries are edible. *Billardiera cymosa.* According to the editor of *Wild Life* (Vol. 7, No. 8, Aug., 1945, p. 226) the fruits of *B. scandens* are eaten by small boys when not too ripe and dry—taste not unpleasant, with an acid tang not unmindful of apples. The similar fruits of *B. cymosa* may therefore have been eaten. Possibly these are the ngurp of Mrs. Smith—native apples that grow on the coast.

Rubus parvifolius. We found the small fruits of the Native Raspberry so dry as not to be worth eating.

SEEDS: Mrs. Smith refers to Caudaart seed. We have been unable to ascertain what this was unless it was an Acacia seed. *Acacia longifolia* var. *Sophorae* is very abundant on the coastal sand-hills and as far inland as the Belt. Doubtless its seeds were collected, ground and eaten and perhaps those of Golden Wattle (*A. pycnantha*). Nal-a-wort, the broad-leaved Wattle, probably refers to the latter species rather than the former.

GUM: The Golden Wattle and other Acacias provided an abundance of slightly sweet gum. Mrs. James Smith mentions "a basket full of wattle gum".

ROOTS AND TUBERS: The Bulrush (*Typha angustifolia*)—nur-nat, a bulrush—is abundant in watery situations and the roots were gathered. G. French Angas refers to its use on the lower Murray (pp. 54 and 59) and near Lake Alexandrina (p. 59) where he noticed a piccaninny on its mother's back chewing the favourite bulrush root, a large net of which was suspended from its mother's shoulders. It was cooked, he says, upon a heap of limestone with wood laid over the top and then fire applied. Roots were placed on the stones, another layer of hot stones put over them and wet grass used to create steam and then a mound of sand formed over the oven. A bulrush root was estimated by Miss J. Cleland to contain 20 per cent. of starch.

Tubers of Triglochin procera. This plant is common in water, has long strap-like leaves and edible swollen roots.

Rhizomes of the Bracken Fern (*Pteridium aquilinum*). These are roasted and eaten in some parts of Australia and probably were so by the Buandik, as is suggested by its having a native name "maa-aa, the fern root". This native word appears in the name of Glen's Station "Mayurra"[2] and the district Hundred near Millicent.

Tubers of Scirpus maritimus. This sedge has edible tubers on its roots. The species doubtless occurs in the South-East, though we did not come upon examples of it. The hard tubers of this plant from Encounter Bay were estimated by Miss J. Cleland to contain 25 per cent. of starch.

[2] The vocabulary in Mrs. Smith's book gives "Maayera—Mr. Glen's station (literally, fern straw)". Unpublished manuscripts of the late Duncan Stewart contain the following: "Maa-yera—Ferny land" and "Mayura = Meayera; fern strawa".

Tuberous roots of Oxalis corniculatus. This small native sorrel has swollen roots which are edible. G. F. Angas (I, p. 85) in his general account of the natives of South Australia states that the women "dig various roots, particularly those of the sorrel (*Oxalis*), and smaller species of Xantharaea (*Xanthorrhoea*), or grass tree; for which purpose they use a stout pointed stick, about five feet long, called a katta".

LEAVES: The bases of the leaves of the Sword-rush (*Lepidosperma gladiatum*) and of the Grass-tree (*Xanthorrhoea australis*) were chewed, perhaps after cooking. If a form of *Sonchus asper* found in swampy country in the South-East is an indigenous species, as it may be, doubtless its leaves were eaten.

Native Stinging Nettle (*Urtica incisa*). This is common in the swamps and G. French Angas (I, p. 54) records that it was eaten on the Lower Murray in times of scarcity, being baked between hot stones. It may also have been eaten in the South-East.

HONEY FROM FLOWERS: G. French Angas (p. 149) in 1844, near Lacepede Bay noted "heaps of the melliferous cones of the banksia lying round the deserted wurlies of the natives and stated that the natives steeped the cones in water which extracted the honey and provided a sweet beverage. Honey could also be obtained from the flowers of the Grass-tree (*Xanthorrhoea australis*).

Large grubs in trees (as mentioned under "Insect Foods"). The Red Gum (*Eucalyptus rostrata*)—tart-pen-a, the red gum—and the native honey suckle (*Banksia marginata*)—wroit, the honeysuckle—were both infested with large white grubs which the natives ate. *The Sugar-lerp insect* producing "manna" on *Eucalyptus viminalis* is mentioned under "Insect Foods".

Other native names for plants given by Mrs. Smith comprise: Boo-tho, grass. Bo, an eatable root. Mar-o-ngrie and Moor-na, edible roots. Boon-er-do-ir, a mallee-wood spear (probably from *Eucalyptus diversifolia*). We-re-o-dir, a tea-tree spear (probably from the swamp tea-tree, *Leptospermum pubescens*). Boo-in-kool, a reed necklace. Karra, the fern-leaved wattle (*Acacia decurrens*). Mooth-a, the blackwood tree (*A. melanoxylon*). Koora, the tea-tree (*Melaleuca* or *Leptospermum*). Kirp, the boxwood (probably *Bursaria spinosa*). Ngir, sheoak, casuarina (*Casuarina stricta*). M'raa, the stringy-bark tree (*Eucalyptus obliqua* and perhaps the rather similar *E. baxteri*). Ngir-aa-da, the white gum-tree (presumably *E. leucoxylon*). Kel-la-or, *lancewood* (presumably a tree from which spears were made, but the species cannot be suggested unless it is *E. diversifolia*, mentioned above). Mal-a, a swamp weed (identification not possible). Ngurp, native apples that grow on the coast (as munter has already been identified as *Kunzea pomifera* and we know of no other apple-like fruit on the coast, except possibly that of *Billardiora cymosa*), we are at a loss to know to what this name applies unless it is an alternative name for munter, one or other of these names having been dropped for some time on account of the death of someone who bore such a name.

Baron von Mueller (Brough Smyth, I, p. 212) has supplied a list of vegetable substances commonly eaten by the natives of Victoria. As many of these occur also in South Australia, and the South-East is adjacent to Victoria, the following mostly additional sources of vegetable foods available in this State may be inferred: The tubers of numerous terrestrial orchids; the roots of various Liliaceaous plants, e.g., *Thysanotus patersonii* R. Br., *T. tuberosus* R. Br., *Burchardia umbellata* R. Br., *Anguillaria dioica* R. Br., *Caesia vittata* R. Br. and *Bulbine bulbosa* (R. Br.) Haw; the tuberous roots of *Geranium pilosum* Forst., of the sedge *Scirpus maritimus* L. and of the bulrush *Typha angustifolia* L.; the young shoots, bases of the leaves and young flower-stalk and spike of the grass-tree *Xanthorrhoea australis* (and probably *X. semiplana* R. Br.); leaves of *Nasturtium terrestre*

(Leyss.) DC. (which grows in the swamps of the Murray), and of several species of *Cardamine* and *Lepidium*, for cress; the mucilaginous seeds of the native flax *Linum marginale* A. Cunn.; leaves of the clover-sorrel *Oxalis corniculata* L.; the gum of *Acacia decurrens* Willd. var. *mollis* Lindl. as well as of the Golden Wattle; the berries of the Native Elder *Sambucus gaudichaudiana* DC. (recorded in South Australia from the Glenelg River to Beachport); the sweet flowers of several species of *Lomandra* (*Xerotes*); and the large sclerotium of *Polyporus mylittae* dug out of the ground and known as Native Bread.

Detailed Notes on the Vegetation of the Camp Site Areas Investigated.

Cape Buffon Site.—The coastal sand-dunes are probably little altered in spite of the laying out of Grey-town at Cape Buffon which never materialized. To-day there is an abundance of bushes of *Acacia longifolia* (yielding seeds for grinding) and of *Leucopogon parviflorus* (with edible white fruits) with in sheltered places large-fruited *Eucalyptus leucoxylon* and Black Tea-tree (*Melaleuca pubescens*). *Spinifex hirsutus*, as then, runs over the shifting sand and helps to bind it. On the banks overlooking the sandy bay the native *Sonchus megalocephalus* spreads out its roots and may have furnished edible leaves. Sea-rocket (*Cakile maritima*), now on the strand, Mr. J. M. Black considers an introduced plant. The spreading and rooting prostrate muntries (*Kunzea pomifera*), not only help to bind the sand but produce here unusually large edible fruits with a strong apple flavour. There are various other maritime shrubs such as *Olearia axillaris* and *Scaevola calendulacea* and the growth in general is one of dense shrubby vegetation immediately behind the beach.

Lake Frome Site. In spite of periodic bush-fires and recently the drying effects of the cutting of drains, the vegetation between the coastal dunes and the Woakwines is probably little changed. The sandy sites are, in places where still stable, covered with a thick growth of Black Tea-tree (*Melaleuca pubescens*) up which often climbed *Tetragonia implexicoma* or *Muehlenbeckia adpressa* and there were occasional plants of *Rhagodia baccata* and other undershrubs and quite often large plants of Kangaroo Apple (*Solanum aviculare*) with edible (?) fruits.

The low-lying land now drained is at present and probably was then covered with colonies of sedges (*Cladium junceum* and *Cladium glomeratum*), of the cutting grasses *Gahnia psittacorum* (near deeper water) and *G. trifida*, of rushes (*Juncus maritimus* var. *australiensis*), of bulrushes (*Typha*) and of Swamp Tea-tree (*Leptospermum pubescens*) near water. In the water grew in places *Triglochin procera* with long strap-like leaves and edible roots. In summer when the swamps were partly dry a close sward was (and is) composed of *Selliera radicans*, *Halorrhagis brownii*, *Hydrocotyle* (2 species) and other prostrate or minute plants. Beside permanent water, the soft swamp Tea-tree *Leptospermum pubescens* is still to be found and probably was much more extensive before the draining.

The site inspected in this area consists of low sandhills ,about 15 feet high and drifting, with many shell-strewn camp sites exposed (A), surrounded at a level just above that of the surrounding swampy plain by a dense belt of scrub (B) a hundred yards or less in extent, which passes at once into the open flat ground (C), swampy always in winter and even now though drained showing patches of water (L. Frome) in summer.

A. The vegetation on the sandhills where drift has not disturbed it consists of extensive bushes of *Acacia longifolia* (with abundant seeds tending to remain attached in the pods), *Leucopogon parviflorus* (Native Currant, small white

edible fruits much eaten by birds and mammals), *Acacia pycnantha* (Golden Wattle), *Melaleuca pubescens* (Black Tea-Tree), and *Olearia axillaris*. Fairly numerous undershrubs were the prostrate *Acaena Sanguis-orbae*, the pea *Swainsona lessertiifolia* and the tussocky sedges *Scirpus nodosus* and *Lepidosperma gladiatum*. Other occasional small trees, shrubs, undershrubs and herbs were: Grasses (*Poa* and *Danthonia*), *Dianella, Casuarina stricta, Rhagodia baccata, Samolus repens, Erythraea centaurium, Sebaea ovata*, the creeping and rooting *Selliera radicans, Solanum aviculare, Erechtites prenanthoides, Senecio lautus, Helichrysum ferrugineum* and *H. cinereum*. Introduced plants were: Marram Grass (planted), Red Pimpernel, *Sonchus oleraceus* (Sow-Thistle), *S. asper* (perhaps native), and *Hypochoeris* (Cat's-ear).

The plants producing possible food for man consist of: *Acacia longifolia* and perhaps *A. pycnantha*—seeds for grinding. *Solanum aviculare* and *Leucopogon parviflorus*—fruits. The bases of the leaves of *Lepidosperma gladiatum*.

The carmine-coloured berries of *Rhagodia baccata*, staining the fingers pinkish-red, a plant abundant near the seashore as at C. Buffon on Rivoli Bay, may have been the plant that was used by the native girls further north to colour their cheeks red as mentioned by G. F. Angas.

B. The belt of dense scrub. This is so dense that one can make one's way through it only with considerable difficulty. In places the moving sand forms an almost vertical wall some 8 or 10 feet high from which one can look down on the dense matt of shrubs. The principal shrubs and small trees are: Swamp Leptospermum (*L. pubescens*), Black Tea-tree (*Melaleuca pubescens*), *Solanum aviculare*, the trailing *Muehlenbeckia adpressa, Tetragonia implexicoma* (a trailer, sometimes hanging in festoons from the trees) and *Melaleuca squarrosa*. In addition, the following were scattered through this belt: The creeping *Selliera radicans* in open spaces, *Gahnia trifida* (Cutting-Grass), *Rhagodia baccata, Urtica incisa* (Native Nettle), *Rumex* (introduced Dock), the parasitic creeper *Cassytha pubescens* (fruits eaten), the climbing *Comesperma volubile, Adriana Klotzschii, Hibbertia billardieri, Epilobium, Apium australe, Hydrocotyle hirta?* (forming a matt on swampy ground), *Mentha pulegium* (introduced), Red Pimpernel (introduced), *Samolus repens, Solanum nigrum* (Bittersweet, fruits perhaps eaten), *Verbascum virgatum* (introduced), *Helichrysum ferrugineum, Cassinia spectabilis, Hypochoeris radicata* (introduced), Black Thistle (*Cirsium lanceolatum*), *Sonchus asper* (the form with long narrow leaves, perhaps a native—Angas mentions finding Sow-Thistles here in 1844) with edible, not bitter leaves.

C. The flat swampy land now mostly drained. In places round the edge was a matt of small umbellifer, *Hydrocotyle tripartita*, with divided leaves, *H. plebeja* and *Selliera radicans*. Large patches of vegetation were formed of *Cladium junceum*.

Amongst the lowly matt plants were scattered *Halorrhagis brownii, Samolus repens, Lobelia anceps, Triglochin striata, Epilobium glabellum* and the grass *Agrostis avenacea*. There were large clumps of the Cutting Grass *Gahnia trifida* and a good deal of the tall rush *Juncus maritimus* var. *australiensis*. As one approached the bare patches where water lay in winter, a sedge (*Cladium glomeratum*), eighteen inches or so high, occupied the surface to the exclusion of almost all else, though coarse tufts of the introduced New Zealand Fescue were quite common and Bulrushes (*Typha angustifolia*) formed colonies and between these occasional plants of *Apium australe*, of the grass *Polypogon monspieliensis*, of the introduced Cat's-ear (*Hypochoeris radicata*), of a Samphire, of the grass *Sporo-*

bolus virginicus, of a small *Scirpus* and of the Billy-button (*Cotula coronopifolia*) were noted.

In swampy land elsewhere, as at the Narrow Neck, *Triglochin procera* was noted, a swampy plant with edible roots, and where water was more permanent the big Cutting Grass (*Gahnia psittacorum*).

Of the above marsh plants, the only ones that are likely to have provided a food supply are the Bulrush whose roots are said to have been eaten and *Triglochin procera* which furnished edible roots. It is possible that the Native Celery (*Apium australe*) may have been used.

THE BELT SITE. The site, once nearly surrounded by swamps, at least in winter, consists of hillocks of nearly white sand about 13 feet high running into each other to form a sandy ridge, and weathering to expose lumps and miniature "ranges" (a few yards long and a foot or so high) of travertine limestone on top of the dune rock. The sandy hillocks are now covered with abundant bracken (*Pteridium aquilinum*), blady grass (*Imperata cylindrica* var.) being interspersed in places. Rising from this are occasional shrubs or small trees of *Banksia marginata*, Golden Wattle (*Acacia pycnantha*), Blackwood (*A. melanoxylon*) and here and there Sheoaks (*Casuarina stricta*), *Myoporum insulare* (Juniper-bush) and *Bursaria*. Amongst the bracken *Carpobrotus aequilaterus* (Pig-face), *Swainsona lessertiifolia*, the sedge *Scirpus nodosus*, *Erechthites quadridentata* and *Acaena Sanguis-orbae* are undershrubs. Taller shrubs are *Solanum aviculare*, *Acacia longifolia*, *Dodonaea viscosa*, *Leucopogon parviflorus* and *Xanthorrhoea australis*. The latter protects the surface soil for a while so that it remains on pedestals as it were in the denuding zone. Other herbs and undershrubs are *Oxalis corniculata*, *Senecio lautus*, *Erechthites quadridentata*, *Danthonia* sp. (Wallaby Grass), *Themeda australis* (Kangaroo Grass), *Agrostis avenacea* (Blown Grass), *Juncus pallidus* (Pale Rush), *Dianella*, *Rumex brownii*, *Cynoglossum australe* and *Solanum nigrum*.

Introduced species consist of: *Lagurus ovatus*, *Briza minor*, Box-thorn, *Rumex Acetosella*, Red Pimpernel, *Verbascum virgatum*, *Inula graveolens* (Stinkwort), *Cirsium lanceolatum* (Black Thistle), *Sonchus asper* (Prickly Sow-Thistle) and *Hypochoeris* (Cat's-ear).

A quarter-mile to the east of the site, the trees become denser and taller with many tall Golden Wattles, and Banksias and some large Blackwoods as well as Stringy-bark (*Euc. baxteri*). Here there is a dense undergrowth of Bracken. Other plants found here are *Lomandra longifolia*, *Muehlenbeckia adpressa*, *Kennedya prostrata*, *Hibbertia sericea* and *Olearia axillaris*.

The following are possible food-plants: *Xanthorrhoea* and *Banksia*—honey from flowers. *Carpobrotus* (*Mesembrianthemum*) *aequilaterus*, *Leucopogon parviflorus*, *Solanum aviculare* and *S. nigrum*—fruits. *Acacia longifolia* and perhaps *A. pycnantha*—seeds for grinding. *Oxalis corniculata*—roots. *Xanthorrhoea*—bases of leaves. *Banksia*—harbours edible grubs. Golden Wattle—gum.

WOAKWINE RANGE SITES. SITES, WK. 9, 10, 11, 12, 13. The Woakwine Range in the neighbourhood of Rendlesham is poorly covered with vegetation which consists of scattered Black Tea-trees (*Melaleuca pubescens*) with occasional Sheoaks, Xanthorrhoeas, and shrubs of *Acacia longifolia*, *A. pycnantha*, the Kangaroo Apple (*Solanum aviculare*) and Native Box (*Bursaria spinosa*). North of Beachport, a mallee (*Eucalyptus diversifolia*) grows extensively.

WOAKWINE STATION SITE (WK. 8). This site in the inland side of the Woakwine Range presented a bare appearance with areas of drifting sand exposing old camp sites and only scattered Black Tea-trees (*Melaleuca pubescens*) with occasional Sheoaks (*Casuarina stricta*), a few Eucalypts in patches, and odd Grass-trees (*Xanthorrhoea australis*), Wattles (*Acacia longifolia* and *A. pycnantha*),

Blackwoods (*Acacia melanoxylon*), Kangaroo Apples (*Solanum aviculare*), and Native Box (*Bursaria spinosa*). Some of the roots of the Black Tea-trees, exposed by the sand-drift, ran out horizontally for 25 feet at least. A few smaller plants were noted such as some Bracken (*Pteridium aquilinum*), *Erechthites prenanthoides, Senecio lautus, Acaena Sanguis-orbae* (a burr), *Goodia lotifolia* (one plant), an introduced Mignonette (*Reseda luteola*) and the introduced Red Pimpernel.

REEDY CREEK SITES (RC. 1, 2 and 3). The Reedy Creek Range, as seen near Furner, presents a still more fertile or perhaps mature and certainly older condition of the consolidated dunes. In places it appears as open scrub with Pink Gums (*Eucalyptus fasciculosa*), Stringy-barks, Acacias and other shrubs, and in other parts as more open country with two dwarf species of Casuarina (*C. paludosa* and *C. muelleriana*), low Hakeas, *Isopogon ceratophyllus, Darwinia micropetala* and heath-like plants.

AREA BETWEEN THE WOAKWINE RANGE AND THE MT. BURR–MT. MUIRHEAD–REEDY CREEK RANGE SYSTEM. The flat country between the Woakwines and the Reedy Creek Range–Mt. Graham–Mt. Muirhead (the Millicent and Hatherleigh flats) has long been drained and its vegetation profoundly altered. Early descriptions of it show that in winter much was under water and that in summer it became in parts at least dry. The vegetation originally probably resembled that at present round Lake Frome on the west of the Woakwines. Tussocks of the Cutting Grass *Gahnia trifida* were sure to be abundant, the larger Cutting Grass (*G. psittacorum*) with nearly black rather drooping flowering branches, broad serrated leaves and reddish nuts being confined to place where the water was more permanent. Here also would grow the silky Tea-tree (*Leptospermum pubescens*), Bulrushes and *Triglochin procera*. Sedges (*Cladium, Lepidosperma* and *Chorizandra*), and Rushes (*Juncus maritimus* var. *australiensis* and *J. pallidus*) formed colonies often very extensive, and low mat-like plants, as detailed previously, must have covered the ground in places when the waters receded.

VEGETATION IN THE CAPE BANKS–BLACKFELLOWS CAVES AREA. With the extensive draining of the low-lying swampy portions of this area and the clearing of the drained land and of the adjacent ridges, the appearance of the country has been profoundly altered since European occupation. Near Cape Banks, however, and close to the south end of Lake Bonney and again close to Blackfellows Caves some patches of very dense scrub still remain, through which meander shallow watercourses not yet effectively drained. The undergrowth is so dense that it is difficult to make one's way through it, unless along a cleared track. In this vegetation, the Red Mite (*Trombiculum samboni* Womersley) is now abundant and readily attaches itself to anyone lingering amongst the thick undergrowth. Introduced rabbits feed round the edges and many of these have mites in their ears, an area to which they seem to make. The rabbit has evidently been responsible for a great increase in this pest. It is likely that during the native occupation they were much less numerous, as marsupial and rodent hosts were probably far fewer than the rabbits are now.

The trees in this dense scrub consist chiefly of Stringy-bark (*Eucalyptus obliqua*) with Blackwood (*Acacia melanoxylon*) and occasional Native Cherries (*Exocarpus cupressiformis*) and Swamp Gum (*Eucalyptus ovata*) and shrubs such as Silky Tea-tree (*Leptospermum pubescens*), Black Tea-tree (*Melaleuca pubescens*), *Melaleuca squarrosa* and smaller shrubs and undergrowth. In the swampy patches, the fern *Blechnum capense* may be found with Cutting Grass (*Gahnia trifida*) and a tall slender form of the grass *Agrostis avenacea*. On the limestone rocks round the edge *Grevillea ilicifolia* trails over the ground and the undershrubs *Lasiopetalum* and *Pomaderris* may be found.

The swamps that remain undrained have a vegetation similar to that described for the Rivoli Bay area, with sedges a dominant factor. Round the sea side of the south end of Lake Bonney the sedge (*Cladium glomeratum*) is in almost a pure stand. *Gahnia trifida* is common, the very similar *Cladium filum* occurring in tussocks on the drying drained parts. An interesting find some miles south of Blackfellows Caves was an abundance of the Native Centaury (*Erythraea australis*) in the moist ground round the edge of a swamp.

MISCELLANEOUS BOTANICAL NOTES.

OBTAINING FIRE. "…. If the natives by chance let their fire go out, they can readily get a light out of the grass-tree by procuring two pieces of it, placing one horizontally on the ground and inserting in a notch made in it the end of the other and then twirling the latter rapidly between the palms of the hands. In a short time the sticks will ignite, showing that it is still as capable of setting the bush in a blaze as on the day of Mar" (legendary being). Mrs. Smith, p. 21.

FOMENTATIONS FOR SPRAINS. "Hot fomentations are very beneficial to them. They are applied to sprains in this way: The patient heats a smooth stone, lays a lot of herbs on it, and then lays the sore part of his limbs on the hot herbs. . . . I have often seen women who were ill with rheumatism completely enveloped in leaves. In any case when danger is anticipated, a fire is kindled in the middle of their clod wurla, all kinds of green leaves are heaped on top sufficient to bear the patient, sticks are laid across for him to lie on, a bottle of water is poured on the fire, and the patient is laid on this rude construction to have a good steaming. Care is taken that he does not catch cold; and this operation generally succeeds in curing him." Mrs. Smith, p. 11.

ADHESIVE GUMS USED BY NATIVES. LOWER MURRAY. Barbs of spears were fixed on by resin from the pine that grows on sandy hills near the river, or by grass-tree gum and sand, of which they form a kind of glue. G. F. Angas, *Savage Life and Scenes in Australia etc.* I, p. 93, 2nd Edition. The native pine (*Callitris*) does not grow in this area.

PLANTS AS TOTEMS. Mrs. Smith (p. x) records the following plants as being totems: Honeysuckle, blackwood, stringy-bark, tea-tree scrub, "Boorte moorna" (edible root), sheaoak.

SOFT BUSHES FOR BABIES TO BE WRAPPED IN OR TO LIE ON. "A fine soft bush, called 'dinge' was gathered in handsful and placed round the fire in a circle to dry. This served as baby clothes. A finer kind was gathered for a pillow, when the baby could sit on its mother's back in a mat made of 'nangroo', a large, broad grass (probably *Spinifex hirsutus*) which grows on the sandy beach." Mrs. Smith, p. 5.

SLEEPING ON A BUSHY SHEOAK. "For purpose of safety at night whilst taking rest he would make his bed on the top of a bushy sheoak tree. This feat was exhibited to me; and so cleverly was it done, that to the eye of a casual observer it would not be discernible." Mrs. Smith, p. 58.

SUMMARY OF ABORIGINAL FOODS.

From the foregoing detailed account of possible food sources, the following main points may be summarized as being the most important:

Animal flesh. Kangaroo, Wallaby, Wombat, Opossum, Bandicoots.

Birds. Emu, Native Turkey, Native Companion, Black Swans, Ducks, Moorhens and Water-hens.

Eggs of all the above.

Fish. Small mucilaginous freshwater fish.
Crustaceans. Sea Crayfish.
Shellfish. Turbos, Limpets.
Fruits. Pig-face, muntries, native currants, kangaroo apple.
Seeds. From various acacias.
Gum. From the golden wattle and other acacias.
Roots. Bulrush.
Honey. From Banksia and Grass-tree flowers by infusion in water.

List of plants noted in the Millicent, Mt. Graham, Furner, Rendlesham, Rivoli Bay South area (R.), C. Banks area (B.), and Port MacDonnell area (MacD.).[3]

The authors of the various species will be found in Black's *Flora of South Australia.*

If a species occurs in all three localities, no letters are appended. A star * indicates an introduced species.

FILICALES: *Pteridium aquilinum*, Bracken; *Blechnum capense* (B.).

LYCOPODIALES: *Selaginella Preissiana* (MacD.).

TYPHACEAE: *Typha angustifolia*, Bulrush.

POTAMOGETONACEAE: *Zostera* sp. (B.); *Cymodocea antarctica* (B.); *Lepilaena Preissii* (MacD.); *Posidonia australis* (broad leaves) (B); *Potamogeton tricarinatus* (MacD.); *P.* sp. (MacD.).

SCHEUCHZERIACEAE: *Triglochin striata; T. procera* (R., MacD.).

GRAMINEAE: *Imperata cylindrica* var. *major* (R., MacD.); *Hemiarthria compressa*, Mat Grass (R., B.); *Themeda australis*, Kangaroo Grass; *Zoisia Matrella*, flat near L. Frome (R.); **Paspalum dilatatum* (R.); **Stenotaphrum secundatum*, Buffalo Grass (R., MacD.); *Spinifex hirsutus*, coast; *Stipa teretifolia* (R., C. Buffon, B.); *St. semibarbata* (B.); *St. elatior* ? (R.); **Oryzopsis miliacea*, Rice Grass; *Sporobolus virginicus* (R., B.); *Polypogon monspeliensis; Agrostis Billardieri* (B., MacD.) and var. *filifolia* (R., near Rendelsham); *A. avenacea* (R., B.); **Ammophila arenaria*, Marram Grass; **Lagurus ovatus*, Hare's-tail Grass; **Aira caryophyllea*, Silvery Hair-grass (B., MacD.); **Avena* sp. (MacD.); **Holcus lanatus*, Yorkshire Fog (B., MacD.); *Danthonia* sp. (R., MacD.); *Phragmites vulgaris*, Common Reed; **Cynosurus echinatus*, Rough Dog's-tail (B.); **Koeleria phleoides* (MacD.); **Briza minor*, Lesser Quaking-grass (R., MacD.); **Dactylis glomerata*, Cock's-foot Grass (R., MacD.); *Distichlis spicata* (MacD.); *Poa poaeformis*, coast; **Poa annua*, Annual Meadow-grass (R.. MacD.); **Festuca elatior* ? (R.); **Vulpia bromoides*, Squirrel-tail Fescue (MacD.); **Scleropoa rigida*; **Bromus catharcticus*, Prairie Grass (R.); **B. rigidus*, Great Brome (MacD.); **B. mollis* or *hordeaceus* (MacD.); **Cynodon dactylon*, Couch Grass (R., MacD.); **Lolium perenne*, Rye-grass (R.); **L. subulatum* (MacD.); *Lepturus incurvatus* (MacD.); **Hordeum murinum*, Barley-grass (R., MacD.).

CYPERACEAE: *Schoenus apogon* (MacD.); *S. tesquorum* (MacD.); *S. fluitans* (MacD.); *S. Tepperi* apparently not in flower (R.); *S. nitens* (R., B.); *S. carsei* (MacD.); *Scirpus fluitans*, forma approaching *S. productus* (MacD.); *S. nodosus; S. cernuus; S. inundatus* (R., B.); *S. americanus* (B., MacD.); *Eleocharis acuta* (B., MacD.); *Lepidosperma gladiatum*, Sword Rush; *L. laterale*; *L. semiteres* (B.); *L. carphoides* (R.); *Cladium Mariscus* (*C. procerum* S. T. Blake) (B., MacD.); *C. filum* (B.); *C. articulatum* (MacD.); *C. glomeratum* (B., L. Bonney); *C. Huttoni* (R., near Rendlesham); *C. laxum* (MacD., near Ewen's Ponds); *C. junceum* (B., MacD.); *Gahnia trifida*, Cutting-grass; *G. psittacorum* (R., MacD.—8-mile Creek); *Chorizandra enodis* (R.); *Carex appressa* (MacD.); *C. breviculmis* (MacD.); *C. Gunniana* (MacD.).

ARACEAE: **Zantedeschia aethiopica*, Arum Lily (MacD.).

RESTIONACEAE: *Leptocarpus* ? (R., B.); *Leptocarpus Brownii* (MacD.).

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[3] This list of plants comprises those noted during our two visits and on a previous one to Port MacDonnell in October–November, 1941. On this list is based our assessment of the vegetable sources of food. It cannot be considered as complete, especially as many ephemerals must have escaped notice through not being in flower. But, except perhaps for the bulbs of orchids, the omissions cannot have contributed to the food supply. Such a list can be scrutinized by others who may wish to check our survey. It is unlikely that any species of importance from a food point of view has disappeared from this area. The list serves also as a locality record for the species enumerated.

J. B. CLELAND.

CENTROLEPIDACEAE: *Centrolepis polygyna* (B., MacD.).

JUNCACEAE: *Juncus capitatus* (MacD.); *J. bufonius* (R., MacD.); *J. caespiticius* ? (B.); *J. plebius* ? (MacD.); *J. maritimus* var. *australiensis*; *J. pallidus*; *J. pauciflorus* (B., MacD.).

LILIACEAE: *Dianella revoluta*; *Reya umbellata* (R., MacD.); *Lomandra dura* (B.); *L. longifolia*; *Thysanotus Patersonii* (MacD.); *Th. dichotomus* (R.); *Bulbine semibarbata* (MacD.); *Dichopogon fimbriatus* (MacD.); *Xanthorrhoea australis* (R., B.).

ORCHIDACEAE: *Microtis unifolia* (MacD.); *Eriochilus cucullatus* (B.); *Caladenia carnea* (MacD.).

CASUARINACEAE: *Casuarina stricta*, She-oak; *C. Muelleriana* (R.); *C. paludosa* (R.).

URTICACEAE: *Parietaria debilis* (B., MacD.); *Urtica urens* (B., MacD.); *U. incisa*.

PROTEACEAE: *Isopogon ceratophyllus* (R.); *Hakea nodosa* (MacD.); *H. rostrata* (R.); *H. rugosa* (R.); *Banksia marginata* (R., B.); *Grevillea ilicifolia* (B.).

SANTALACEAE: *Exocarpus cupressiformis*, Native Cherry.

LORANTHACEAE: *Loranthus Preissii* on *Acacia melanoxylon* (R.); *L. pendulus* on *Eucalytus obliqua* (R., B.); *Phrygilanthus eucalyptifolius* on *E. obliqua*, *A. melanoxylon* and *Exocarpus cupressiformis* (B.).

POLYGONACEAE: **Rumex pulcher* (R.); *R. Brownii*; **R. conglomeratus* (R.); **R. crispus* (MacD.); *R. bidens* (MacD.); **R. Acetosella*; **Polygonum aviculare* (R., B.); *P. serrulatum* (R., MacD.); *Muehlenbeckia adpressa*.

CHENOPODIACEAE: *Rhagodia baccata*; **Chenopodium murale*; *Ch. pumilio* ? (B.); *Ch. album* (B.); *Ch. ambiguum* (R., B.); *Atriplex cinereum* (MacD.); *Threlkeldia diffusa* (B.); *Salicornia australis*, Samphire (R., B.); *S. Blackiana* (B.).

AMARANTACEAE: *Trichinium macrocephalum* (R.—near Furner, B.).

AIZOACEAE: *Carpobrotus aequilaterus*, Pigface; *Tetragonia implexicoma* (drupe red, 8 mm. diameter).

CARYOPHYLLACEAE: *Sagina apetala* (MacD.); **Cerastium glomeratum*, Mouse-ear Chickweed (MacD.); **Stellaria media*, Chickweed (R., MacD.); **Minuartia tenuifolia*, Slender-leaved Sandwort (MacD.); **Spergularia rubra* (MacD.); *S. marginata* ? (B.); **Silene vulgaris*, Bladder Campion (B., MacD.); **S. conica* (MacD.); **S. nocturna* (MacD.); **S. gallica*, French Catch-fly (MacD.).

RANUNCULACEAE: *Clematis microphylla*; *Ranunculus rivularis* (B., MacD.); *R. lappaceus* (MacD. Point Douglas); *R. parviflorus* (B., MacD.); **R. muricatus* (MacD.).

LAURACEAE: *Cassytha glabella*, False Dodder (R., B.); *C. pubescens* (R., MacD.).

PAPAVERACEAE: **Papaver hybridum*, Rough Poppy (MacD.); **Fumaria muralis* (MacD.).

CRUCIFERAE: *Cardamine hirsuta* var. *reniformis* (MacD.); **Nasturtium officinale*, Water Cress (B., MacD.); **Sisymbrium officinale*, Hedge Mustard (MacD.); **Brassica adpressa* (R.); **Diplotaxis tenuifolia* (R.); **D. muralis* (B., MacD.); **Alyssum maritimum*, Sweet Alyssum (Robe); *Lepidium hyssopifolium* (B.); *Capsella Bursa-pastoris*, Shepherd's Purse (MacD.); **Coronopus didymus* (R., MacD.); **Cakile maritima*.

RESEDACEAE: **Reseda luteola* (R.).

DROSERACEAE: *Drosera pygmaea* (MacD.); *D. auriculata* (MacD.); *D. peltata* (MacD.).

CRASSULACEAE: *Crassula Sieberiana* (MacD.); *C. recurva*.

PITTOSPORACEAE: *Bursaria spinosa*, Native Box; *Billardiera cymosa* (B., MacD.).

ROSACEAE: *Rubus parvifolius*, Native Raspberry (B., MacD.); **Rosa rubiginosa*, Sweet-Briar (MacD.); *Potentilla anserina*, Silver-weed (R.); *Acaena ovina* (MacD.); *A. sanguisorbae*.

LEGUMINOSAE: *Acacia armata* (MacD.); *A. myrtifolia* (B., MacD.); *A. pycnantha*, Golden Wattle; *A. melanoxylon*, Blackwood; *A. verticillata* (B., MacD.); *A. longifolia* var. *sophorae*; *A. decurrens* var. *mollis*, Black Wattle; *Daviesia ulicina* (B., MacD.); *Pultenaea stricta* (MacD.); *P. graveolens* (B.); *Bossiaea prostrata* (B.); *Goodia lotifolia* (R.); **Ulex europaeus*, Furze (MacD.); **Cytisus prolifer*, Tree Lucern (B.); **Trifolium procumbens*, Hop Clover (MacD.); **T. filifolium* (MacD.); **T. tomentosum*, Woolly Clover (R., MacD.); **T. resupinatum* (MacD.); **T. repens*, White Clover **T. subterraneum* (MacD.); **T. scabrum* (MacD.); **Melilotus indica*, King Island Melilot; **Medicago lupulina*, Black Medic; **M. denticulata*, Toothed Medic (MacD.); *Lotus australis* (R., B.); *Swainsona lessertiifolia*; *S. Behriana* (MacD.); **Vicia sativa*, Common Vetch (MacD.); *Kennedya prostrata*, Scarlet Runner.

GERANIACEAE: *Geranium pilosum* (B.) and var. *australe* (B., MacD.); **G. molle* (B., MacD.); **Erodium cicutarium* (B., MacD.); *Pelargonium australe* (R., B.) and var. *erodioides* (MacD.).

OXALIDACEAE: *Oxalis corniculata*.

LINACEAE: *Linum marginale* (MacD.).

ZYGOPHYLLACEAE: *Zygophyllum* sp. (B.).

RUTACEAE: *Correa rubra* (all) and var. *glabra* (MacD., Ewen's Ponds).

POLYGALACEAE: *Comesperma volubile*; *C. polygaloides* (R.).

EUPHORBIACEAE: *Adriana Klotzschii* (R., B.); **Euphorbia peplus* (R., MacD.); *Beyeria Leschenaultii* var. *latifolia* (R., Rivoli Bay, MacD.).

STACKHOUSIACEAE: *Stackhousia spathulata* (R., MacD.).

SAPINDACEAE: *Dodonaea viscosa* (R.).

RHAMNACEAE: *Pomaderris racemosa* (B.).

MALVACEAE: **Lavatera arborea*, Tree Mallow (B., MacD.); **Malva nicaeensis*; **Modiola caroliniana* (R., Mt. Burr).

STERCULIACEAE: *Lasiopetalum discolor* (MacD.); *L. Schulzenii* (B., MacD.); *Thomasia petalocalyx* (R., B.).

DILLENIACEAE: *Hibbertia sericea* (R., MacD.); *H. Billardieri* (R.).

GUTTIFERAE: *Hypericum gramineum* (MacD.).

VIOLACEAE: *Viola hederacea* (B., MacD.).

THYMELAEACEAE: *Pimelea glauca* (R., MacD.); *P. ligustrina* (MacD.—in dense growth in swampy ground near Ewen's Ponds); *P. serpyllifolia*.

LYTHRACEAE: *Lythrum Hyssopifolia* (MacD.).

MYRTACEAE: *Leptospermum scoparium*; *L. pubescens*, Silky Tea-tree; *Kunzea pomifera* (R.); *Melaleuca gibbosa* (R., near Furner, MacD.); *M. squarrosa*; *M. halmaturorum* (R.); *M. pubescens*, Black Tea-tree; *M. fasciculiflora* (R.); *Eucalyptus Huberiana* (R.); *E. obliqua*, Stringy-bark; *E. Baxteri*, Brown Stringy-bark (R.); *E. rostrata*, Red Gum (R.); *E. ovata*, White Swamp Gum; *E. leucoxylon* (R., MacD.) and approaching var. *macrocarpa* (MacD.); *Darwinia micropetala* (R., scrub, near Furner, heath N. of Rendlesham).

OENOTHERACEAE: *Epilobium junceum* (B.); *E. glabellum*; *E. pallidiflorum* (MacD.).

HALORRHAGIDACEAE: *Halorrhagis tetragyna* (B., MacD.); *H. Brownii*; *Myriophyllum elatinoides* (MacD.); *M. Muelleri* (MacD.).

UMBELLIFERAE: *Centella asiatica* ? (MacD.); *Hydrocotyle vulgaris* (Mt. Gambier); *H. plebeja* (R., B.); *H. tripartita* (R., B.); *Lilaeopsis australica* (B.); *Eryngium vesiculosum* ? (MacD.); *Daucus glochidiatus*, Native Carrot (MacD.); **Conium maculatum*, Hemlock (Mt. Gambier); *Sium latifolium* var. *univittatum* (MacD.); *Apium australe*, Sea Celery; **Foeniculum vulgare*, Fennel (R.).

EPACRIDACEAE: *Astroloma humifusum*, Native Cranberry; *A. conostephioides*, Flame Heath (R.); *Leucopogon parviflorus*; *Acrotriche serrulata* (B., MacD.); *A. cordata* (B.); *Epacris impressa* (R.); *Sprengelia incarnata* (MacD.).

PRIMULACEAE: **Anagallis arvensis*, Scarlet Pimpernel; **A. femina*, Blue Pimpernel (MacD.); *Samolus repens*.

LOGANIACEAE: *Logania ovata* (MacD.).

GENTIANACEAE: *Sebaea ovata* (R., MacD.); *S. albidiflora* (MacD.); *Erythrea australis* (B.); **E. Centaurium*, Common Centaury (R., B.); *Gentiana diemensis* (MacD., on edge of swamp at Ewen's Ponds near Riddoch Bay, probably the site where Tate collected it in 1882 and apparently not collected since); *Villarsia exaltata*.

APOCYNACEAE: *Alyxia buxifolia* (R.); **Vinca major*, Greater Periwinkle (MacD.).

ASCLEPIADACEAE: *Asclepias physocarpa* (R., near Narrow Neck, Rendlesham).

CONVOLVULACEAE: *Convolvulus erubescens*; *Dichondra repens* (R., B.); *Wilsonia Backhousei* (B. ?, MacD.); *Cuscuta tasmanica* (MacD., on lowly plants near swampy ground).

BORRAGINACEAE: *Cynoglossum suaveolens* (MacD.); *C. australe*; *Myosotis australis* (MacD.); **Lithospermum arvense*, Corn Gromwell (MacD.).

LABIATAE: *Ajuga australis* (MacD.); **Mentha Pulegium*, Pennyroyal (R., B.); **Marrubium vulgare*, Horehound; **Salvia Verbenacea*, Wild Sage (R., B.).

SOLANACEAE: *Solanum nigrum*, Black Night shade (R., B.); *S. aviculare*, Kangaroo Apple; **Lycium ferocissimum*, African Boxthorn.

SCROPHULARIACEAE: **Verbascum virgatum*; **V. Thapsus*, Great Mullein (R., flowers whitish, near Rendlesham in Woakwine Range); *Mazus pumilio* (B., MacD.); *Veronica gracilis* (MacD.); **V. Anagallis*, Water Speedwell (R., Swamp near Mt. Graham); *Euphrasia collina* (MacD., in swamp at Ewen's Ponds); **Bartschia latifolia*, also albino plants (MacD.).

LENTIBULARIACEAE: *Utricularia dichotoma* (MacD., Point Douglas).

MYOPORACEAE: *Myoporum insulare* (R., B.).

PLANTAGINACEAE: *Plantago varia* (MacD.); **P. lanceolata*, Ribgrass (R., MacD.); **P. Coronopus*, Buck's-horn Plaintain (MacD.); **P. major*, Greater Plaintain (MacD.).

RUBIACEAE: *Asperula scorparia* ? (MacD.); **Sherardia arvensis* (MacD.); *Galium ciliare* (MacD.); *G. australe* (B.); **G. murale* (MacD.).

CAPRIFOLIACEAE: *Sambucus Gaudichaudiana*, White Elder (B., MacD.).

CAMPANULACEAE: *Wahlenbergia multicaulis* (B.); *W. quadrifida* (MacD.); *Lobelia anceps*; *Pratia pedunculata* (MacD.).

GOODENIACEAE: *Selliera radicans*; *Scaevola calendulacea* (R., Rivoli Bay); *S. aemula* (B.); *S. pallida* (B.).

COMPOSITAE: *Lagenophora stipitata* (MacD.); *Brachycome graminea* (B.); *Olearia pannosa* (MacD.); *O. axillaris*; *O. ramulosa*; *O. glandulosa* (B.); *Cotula filifolia* (MacD.); *C. coronopifolia* (R., MacD.); *C. australis* (MacD.); *C. reptans*; *Centipeda* sp. (R.); *Erechthites prenanthoides*; *E. picridioides* (MacD.); *E. quadridentata* (R., B.); *Senecio lautus*; *S. odoratus* (MacD.); **S. vulgaris*, Common Groundsel (Mt. Gambier); **Cryptostemma calendulaceum*, Cape Dandelion; *Gnaphalium luteo-album* (R., B.); *G. japonicum* (MacD.); *Cassinia spectabilis* (R., very abundant in a young pine plantation at Mt. Burr sawmills looking when in flower like dead young pines); *Helichrysum leucopsidium* (R.); *H. apiculatum* (B.); *H. ferrugineum* (R., B., to a tree 18 feet high); *H. cinereum* (R., near Rivoli Bay); *Podosperma angustifolium* (R., MacD.); *Leptorhynchus tenuifolius* (R., Reedy Creek Range near Furner); *L. squamatus* (MacD.); *Rutidosis multiflorus* (MacD.); **Inula graveolens*, Stinkwort (R.); *Calocephalus Brownii*; **Cirsium lanceolatum*, Spear Thistle; **Carduus tenuiflorus*, Slender Thistle (MacD.); **Silybum Marianum*, Milk Thistle (MacD.); **Centaurea melitensis*, Maltese Cockspur (MacD.); **C. Calcitrapa*, Star Thistle (R.); *Microseris scapigera* (MacD.); **Hypochoeris radicata*, Rooted Cat's-ear; **H. glabra* (MacD.); **Taraxacum officinale*, Dandelion; **Sonchus oleraceus*, Sow-Thistle; **S. asper* ? var., Prickly Sow-Thistle; *S. megalocarpus* (R., Rivoli Bay., B.); **Crepis virens* (Mt. Gambier).

The following additional native species of plants were noted during the expedition to the South-East in February, 1946:

LORANTHACEAE: *Loranthus miraculosus* var. *Melaleucae* on *Melaleuca pubescens*, road to Nora Creina Bay; fruits edible.

CHENOPODIACEAE: *Enchylaena tomentosa*, Ruby Saltbush, Robe, fruits few and small but edible.

AMARANTACEAE: *Hemichroa pentandra*, shores of L. St. Clair.

DILLENIACEAE: *Hibbertia stricta*, C. Buffon.

FRANKENIACEAE: *Frankenia pauciflora*, Robe.

COMPOSITAE: *Vittandinia triloba*; *Senecio orarius*, Bevilaqua Ford near Rendlesham.

GENERAL SUMMARY.

This paper deals with studies of the relics of aboriginal occupation in the coastal areas of County Grey, the Lower South-East of South Australia.

The topography of the area and the aborigines who formerly occupied it are briefly discussed.

Detailed notes and locations of thirty-four camp sites are recorded.

Littoral sites appear to have been temporary camping places, used when gathering and consuming sea foods. Those sites on the ranges and ridges a few miles inland seem likely to have been the more permanent camps.

Notes and lists are included describing the likely foodstuffs of the aborigines —compiled from a study of data gathered on native vegetation and camp food debris, and from reports on the animal and bird life in the days of early white settlement.

From the apparent scarcity of edible and nutritious native fruits, seeds, and other vegetable material, and from reports of aboriginal food habits, it seems likely that vegetable foods formed only a minor part of his diet, his main subsistance being on animal and bird flesh and sea foods.

Fresh water supplies were always abundant in this region. But it is probable that the swampy conditions of vast areas in winter time might also have been such an inconvenience as to be a definite limiting factor to population increase, in spite of the ample water and the animal and bird life which otherwise might have made the region geographically favourable for human occupation. But camping sites occur on the somewhat narrow ridges and ranges—on coastal sites only for the warmer periods. Thus, during protracted winter seasons—with wide, water-covered, inter-ridge valleys—living and hunting areas were restricted. Occurrence of favourable "strategic" hunting places would only accelerate the slaughter of game. Nomadic hunting and food gathering therefore must have been definitely limited.

An account is given of the collection of 2,755 stone implements gathered on the camp areas. Half of this total consists of microlithic forms. Of these latter, Woakwine, Bondi and Buandik Points constitute the majority. Frequency and distribution of microliths reveal features of interest.

Practically all the implements were made from flint, vast deposits of which material occur on the beaches of the Hundred of Kongorong, while other, but less abundant, supplies occur further along the coast to the north-west.

Some notes are included on the geology of the region and on the material alterations of the flint implement material. These subjects have a close bearing on the problem of the antiquity of human occupation. The relative ages of the recent sand-dunes and the consolidated stranded dunes inland raise important questions on which depends the age of any aboriginal relics found in or on these dunes. Report is made of burnt stones—similar to native hearth stones—having been found embedded in dune limestone at several sites.

The paper forms a progressive report on work which, it is hoped, can be continued.

We are much indebted to the Board of the South Australian Museum for interest and assistance in this field work.

Our thanks are due also to the following for valued assistance in various ways which ensured the success of the work: Messrs. D. Schulz and S. Smith, of Rendelsham; Mr. C. Willshire, of Millicent, who provided considerable transport facilities; Mr. and Mrs. R. N. Campbell, of Mt. Gambier; Mr. and Mrs. P. Jackway, of Blackfellows Caves; Mr. A. D. Smith, Deputy Surveyor-General; Mr. H. V. V. Noone, Sir Douglas Mawson, Mr. H. M. Hale, Director, and Mr. B. C. Cotton and Mr. H. Cooper, also of the S.A. Museum staff.

We are indebted to Miss Gwen D. Walsh for making the special sketches of camp sites and stone implements.

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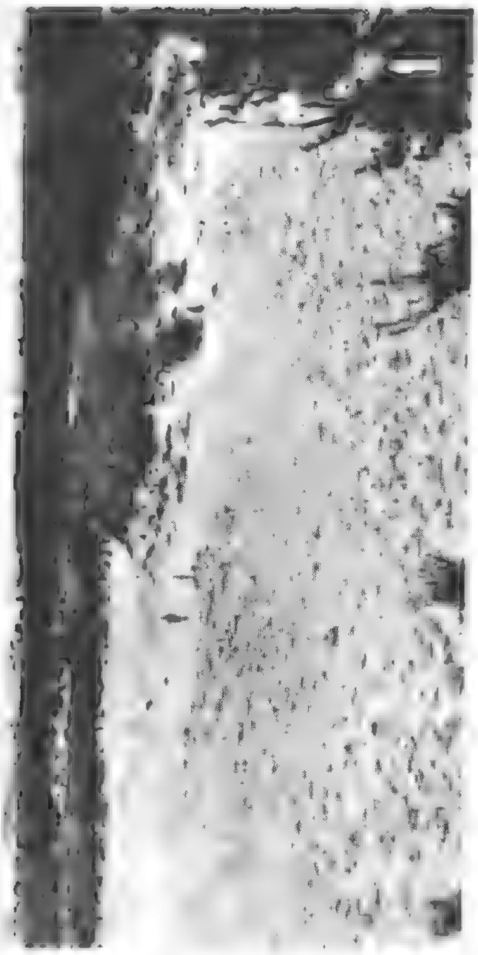
Re notes supplied by Mr. D. Schulz of Rendelsham. His informants were an old uncle (recently deceased), Mr. H. A. Stewart and Mr. S. Smith, both of Rendelsham. The late Mr. H. A. Stewart and Mr. Smith's father were contemporaries of the late Duncan Stewart. All of these persons, including Mr. Schulz, are relatives of the late Mrs. James Smith.

Explanation of Plate vii.

Fig. 1. Portion of the Belt Site.
Fig. 2. Lake Frome, Site 1.
Fig. 3. Hearth remnants.
Fig. 4. Near Blackfellows' Caves.



A KEY TO THE CLASSIFICATION OF THE COWRIES (CYPRAEIDAE)

By W. R. Steadman and Bernard C. Cotton, Conchologist, South Australian Museum

Summary

In the following paper descriptions of Subfamilies are given and keys to both subfamilies and genera. Notes and descriptions of new species and genera are also added under the respective subfamilies, while illustrations of new species and a number holotypes and animals previously described from Fiji are reproduced. Pseudocypraea adamsonii Sowerby we regard as belonging to the Triviidae or to a separate family so that it is not included here. In the lists the genotypes of the various genera are given. The names of species and subspecies are followed by the Author's name and date, after which is added the type locality and then the distribution. The latter is abbreviated by using a system of figures for the Provinces and letters for the Regions. Where an asterisk is placed after a locality, it indicates that we here designate that locality as type locality. The Provinces and Regions agree generally with those accepted by Schilder and Schilder, 1939, with minor alterations, and are here listed.

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Plates viii–xiii

INTRODUCTION.

In the following paper descriptions of Subfamilies are given and keys to both subfamilies and genera. Notes and descriptions of new species and genera are also added under the respective subfamilies, while illustrations of new species and a number holotypes and animals previously described from Fiji are reproduced. *Pseudocypraea adamsonii* Sowerby we regard as belonging to the Triviidae or to a separate family so that it is not included here. In the lists the genotypes of the various genera are given. The names of species and subspecies are followed by the Author's name and date, after which is added the type locality and then the distribution. The latter is abbreviated by using a system of figures for the Provinces and letters for the Regions. Where an asterisk is placed after a locality, it indicates that we here designate that locality as type locality. The Provinces and Regions agree generally with those accepted by Schilder and Schilder, 1939, with minor alterations, and are here listed.

Province.	Region.
1. West American	(a) Californian, (b) Mexican, (c) Galapagos.
2. East American	(a) Bermudian, (b) Caribbean, (c) Brazilian.
3. Eurafrican	(a) Southern Atlantic, (b) Guinean, (c) Canarian, (d) Algerian, (e) European.
4. Indian	(a) Erythraean, (b) Persian, (c) Cape of Good Hope, (d) African, (e) Lemurian, (f) Indian.
5. Central Indopacific	(a) Sumatran, (b) Moluccan, (c) Java Sea, (d) Sulu Sea, (e) Japanese, (f) Dampierian, (g) Flindersian.
6. Pacific	(a) Solanderian, (b) Peronian, (c) Melanesian, (d) Samoan, (e) Oceanic, (f) Micronesian, (g) Polynesian, (h) Hawaiian.

Subfamilies.

Although subfamilies of the *Cypraeidae* have been recognized and used by recent authorities, the definition of them has been somewhat vague. We here describe and key the accepted subfamilies, carefully basing the descriptions on typical genera and using the salient features in the key.

KEY TO SUBFAMILIES.

a. Globular and beaked .. .. *Pustulariinae*
aa. Not globular or beaked.
  b. Pustulose or granulose .. .. *Staphylaeinae*
  bb. Smooth.
    c. Deeply umbilicate .. .. *Umbiliinae*
    cc. Not deeply umbilicate.
      d. Teeth weak and incomplete .. .. *Zoilinae*
      dd. Teeth normally developed.
        e. Outer lip characteristically produced posteriorly .. *Cypraeovulinae*
        ee. Outer lip normal.
          f. Malleated .. .. *Austrocypraeinae*
          ff. Not malleated.
            g. Shell cylindrical.
              h. Teeth fine .. .. *Talpariinae*
              hh. Teeth coarse .. .. *Erroneinae*
            gg. Shell pyriform or ovate.
              i. Pyriform .. .. *Adustiinae*
              ii. Ovate or elongate ovate.
                j. Elongate ovate .. .. *Nariinae*
                jj. Ovate.
                  k. Base spreading.
                    l. Hump backed .. .. *Mauritiinae*
                    ll. Not hump backed .. .. *Erosariinae*
                  kk. Base not spreading .. .. *Cypraeinae*

Subfamily Pustulariinae.

Twenty millimetres in length or less; globular; extremities beaked; irregularly spotted or unicoloured; smooth or granulose; teeth very fine, not produced across the base; margin not calloused; weakly umbilicate; base rounded, not spreading.

Schilder, 1938, 125 places a number of genera, including the type of this subfamily, under Nariinae, but it is a heterogenous group of which *Pustularia* is a quite distinct type. Genera are: *Pustularia* Swainson, 1840, *Cypraea cicercula* Linné, 1758 = *Epona* H. & A. Adams, 1854, same genotype. *Propustularia* Schilder, 1927, *Cypraea surinamensis* Perry, 1811. *Annepona* Iredale, 1935, *Pustularia mariae* Schilder, 1927 = *Cypraea annulata* Gray, 1828, *nom. nud.* *Ipsa* Jousseaume, 1884, *Cypraea childreni* Gray, 1825.

KEY TO GENERA OF *PUSTULARIINAE*.

a. Prominently beaked.
  b. Pustulose .. .. *Pustularia*
  bb. Smooth .. .. *Propustularia*
aa. Moderately beaked, smooth or vermiculate.
  c. Smooth .. .. *Annepona*
  cc. Vermiculately striate all over .. .. *Ipsa*

Subfamily Staphylaeinae.

Thirty millimetres in length or less; elongate ovate; extremities produced; regularly spotted; granulose; teeth strong, more or less produced across the base; margin not calloused; not umbilicate; base rounded, not spreading. Genera are: *Staphylaea* Jousseaume, 1884, *Cypraea staphylaea* Linné, 1758. *Purperosa* Iredale, 1935, *Purperosa facifer* Iredale, 1935. *Nuclearia* Jousseaume, 1884, *Cypraea nucleus* Linné, 1758. *Eustaphylaea* gen. nov., *Cypraea semiplota* Mighels, 1845.

Genus EUSTAPHYLAEA nov.

Genotype, *Cypraea semiplota* Mighels, 1845.

Shell elongate ovate, light brown with numerous minute white spots; base tumid, white, aperture yellowish, narrow; extremities produced; teeth moderately strong, somewhat produced across the base; margin not calloused but slightly ridged on the outer side. Length 9–21 mm.; width 6–11 mm.

KEY TO GENERA OF *STAPHYLAEINAE*.

a. Weakly or obsoletely granulose.
 b. Weakly granulose.
  c. Teeth right across the base .. .. *Staphylaea*
  cc. Teeth not right across the base .. .. *Purperosa*
 bb. Obsoletely granulose .. .. *Eustaphylaea*
aa. Strongly granulose .. .. *Nuclearia*

Subfamily UMBILIINAE.

One hundred millimetres in length or less; elongate ovate; extremities produced; irregularly spotted or unicoloured; smooth; teeth weak, not produced across the base; margin not calloused; deeply umbilicate; base rounded, not spreading. *Umbilia* Jousseaume, 1884, *Cypraea hesitata* Iredale, 1916.

The Tertiary *Rhynchocypraea*, *Palliocypraea*, and *Gigantocypraea* belong here with the recent cold water *Umbilia*. They are sufficiently closely related to the typical *Cypraeaidae* to be regarded as a subfamily only.

Subfamily ZOILINAE.

Seventy-five millimetres in length or less; elongate ovate; spire elongate; extremities produced; irregularly spotted; smooth; teeth weak and incomplete; margin not calloused; not umbilicate; base rounded, not spreading. The development of the teeth range from the practically edentulous *Bernaya* to the partly developed teeth of *Zoila* and the complete, though weak set of *Siphocypraea*. Genera are: *Zoila* Jousseaume, 1884, *Cypraea friendii* Gray, 1831. *Bernaya* Jousseaume, 1884, *Cypraea media* Deshayes, 1831. *Siphocypraea* Heilprin, 1887, *Cypraea mus* Linné, 1758. This subfamily and the next, *Cypraeovulinae*, are represented only in Africa and Southern Australia, each forming a peculiar and restricted subfamily of ancient lineage.

Zoila episema Iredale, 1939, holotype Cape Naturaliste, S.W.A., is in the South Australian Museum D. 3980. It was evidently purchased by Mrs. Kenyon from someone for £20 as the type of *thatcheri* Cox. However, that type was sent to England by Cox according to Sowerby.

Cypraea marginata Gaskoin, 1848, is a juvenile *thersites*, the latter name having page priority.

KEY TO GENERA OF *ZOILINAE*.

a. Practically edentulous .. .. *Bernaya*
aa. Weakly developed teeth.
 b. Series of teeth incomplete .. .. *Zoila*
 bb. Series of teeth complete .. .. *Siphocypraea*

Subfamily CYPRAEOVULINAE.

Forty-five millimetres in length or less; pyriform; extremities well produced, especially the outer lip posteriorly in a characteristic curve; typically umbilicate; spotted, blotched or unicoloured; typically spirally irregularly striate but usually smooth; margin calloused; base rounded; teeth coarse or fine, produced across the base or obsolete. Genera are: *Cypraeovula* Gray, 1824, *Cypraea capensis* Gray, 1828. *Luponia* Gray, 1832 = *Gaskoinia* Roberts, 1870, *Cypraea algoensis* Gray, 1825. *Notocypraea* Schilder, 1927, *Cypraea piperita* Gray, 1825. *Guttacypraea* Iredale, 1935, *Cypraea pulicaria* Reeve, 1846. *Thelxinovum* Iredale, 1931, *Thelxinovum molleri* Iredale, 1931. The Southern Australian genera of small cowries obviously belong here, and have nothing to do with Austrocypraeinae. Like Zoilinae, the teeth are here typically weakly developed. For the pure cream or white species, which is so distinct from other *Notocypraea*, we have used the name *subcarnea* Beddome, 1896, which occurs in Tasmania and South-Eastern South Australia. We have beautiful pure white specimens taken alive by Mrs. L. A. Elliott at Port Macdonnel, South Australia.

KEY TO GENERA OF *CYPRAEOVULINAE*.

a.	Spirally irregularly striate	*Cypraeovula*
aa.	Smooth.	
b.	Umbilicate	*Luponia*
bb.	Not umbilicate.	
c.	Spire not elevated.	
d.	Fossula moderately concave	*Notocypraea*
dd.	Fossula deeply concave	*Guttacypraea*
cc.	Spire elevated	*Thelxinovum*

GUTTACYPRAEA EUCLIA sp. nov.

Shell small, smooth, greyish-white, narrowly pyriform, extremities slightly produced; slightly umbilicate, whole of spire visible; outer margin white, narrowly calloused, forming a narrow ridge; base rounded, not calloused; teeth very fine and short. Length 24 mm., width 13 mm. (holotype). Range 12–24 mm., and 9–13 mm.

Loc. Western Australia, ninety miles west of Eucla, 100 fathoms (holotype); also 40 miles west of Eucla, 116 fathoms.

Remarks. Holotype. D. 11634, South Australian Museum. From a series of this species before us we can readily separate *pulicaria*, a cream to light-pink, brown spotted species from shallow water.

GUTTACYPRAEA PULICARIA Reeve, 1846.

Although the shell is commoner in South-Western Australia, two or three specimens from Spencer Gulf and Gulf St. Vincent, South Australia, dredged in shallow water, are before us, as well as a couple of specimens in the Kenyon collection possibly from Victoria.

Subfamily AUSTROCYPRAEINAE.

Thirty-five millimetres in length or less; pyriform; extremities produced, spire typically visible; unicoloured, obscurely spirally banded; malleated; teeth fine, not produced across the base; margin not calloused; not umbilicate; base

rounded, not spreading. Genera are: *Austrocypraea* Cossman, 1903, *Cypraea contusa* McCoy, 1877 = *Prolyncina* Schilder, 1927, *Cypraea reevei* Sowerby, 1832. Although there are eight Tertiary fossil species of this genus, there is only one living species, *reevei*, confined to South-Western and South Australia, and it is taken alive in both shallow and deeper waters down to 100 fathoms.

Subfamily TALPARIINAE.

One hundred and twenty millimetres in length or less; cylindrical, depressed; extremities slightly produced; not umbilicate; spotted, speckled, or ringed; smooth; teeth fine, not produced across the base; margin not calloused; base slightly flattened, not spreading. Genera are *Talparia* Troschel, 1863, *Cypraea talpa* Linné, 1758. *Basilitrona* Iredale, 1930, *Cypraea isabella* Linné, 1758. *Arestorides* Iredale, 1930, *Cypraea argus* Linné, 1758. *Luria* Jousseaume, 1884, *Cypraea lurida* Linné, 1758. *Chelycypraea* Schilder, 1927, *Cypraea testudinaria* Linné. 1758. *Macrocypraea* Schilder, 1930, *Cypraea zebra* Linné, 1758 = *Cypraea exanthema* Linné, 1767 = *Erythraea* Mörch, 1877, not Sowerby, 1839.

The relationship of *Macrocypraea zebra* is with *argus* in shape and apertural features.

BASILITRONA ISABELLA LEMURIANA subsp. nov.

This name is introduced for the geographical subspecies of *isabella* from Madagascar, the type locality, and the Lemurian Region. The shell is more subovate, extremities attenuated rather gradually instead of abruptly constricted, sides more callous, hind top of inner lip less distinctly constricted and never bent to the left; the extremities practically plain orange, without brown or even blackish spots. The Schilders, 1939, recorded this subspecies as typical *isabella*, but *isabella* comes from Amboina—the Schildes *ramphii* introduced by them for the Malayan species is a direct synonomy for the typical *isabella*.

KEY TO GENERA OF *TALPARIINAE*.

a. Banded.	
b. Base dark brown	*Talpa*
bb. Base not dark brown.	
c. Extremities dotted or coloured.	
d. Teeth fine, extremities orange	*Basilitrona*
dd. Teeth coarser, extremities with two dark spots	*Luria*
aa. Spotted, speckled or ringed.	
e. Speckled and blotched	*Chelycypraea*
ee. Not speckled.	
f. Ringed	*Arestorides*
ff. Spotted	*Macrocypraea*

Subfamily ERRONEINAE.

Fifty millimetres in length or less; elongate cylindrical; extremities moderately produced; slightly umbilicate; dorsally blotched, regularly speckled or obscurely banded; smooth; teeth coarse or fine, not produced across the base; margin weakly, moderately, or strongly calloused; base typically rounded, not spreading. Genera are: *Erronea* Troschel, 1863, *Cypraea errones* Linné, 1758. *Bistolida* Cossmann, 1920, *Cypraea stolida* Linné, 1758. *Derstolida* Iredale, 1930, *Derstolida fluctuans* Iredale, 1930. *Talostolida* Iredale, 1930, *Cypraea teres* Gmelin, 1791. *Palangerosa* Iredale, 1930, *Cypraea cylindrica* Born, 1780. *Ova-*

tipsa Iredale, 1931, *Cypraea chinensis* Gmelin, 1791. *Ipserronea* Iredale, 1935, *Ipserronea problematica* Iredale, 1935. *Blasicrura* Iredale, 1930, *Cypraea rhinoceros* Souverbie, 1865. *Cypraea "latior"* Melvill, 1888, is a mutation which is liable to occur in any of the *teres* complex.

ERRONEA ERRONES BARTLETTI sp. nov.

Shell medium to small; cylindrical; extremities moderately produced; slightly umbilicate; regularly speckled with brown on a greenish-grey background and obscurely marked with three darker zonal bands; base pink, margins pinkish brown, interstices of teeth orange-red, teeth diminished, columella teeth becoming obsolete, short and more prominent across the shallow fossula. Length 40 mm., width 22 mm. (holotype). Range 23–40 mm., and 15–22 mm.

Loc. Rossell Island, New Guinea.

Remarks. We have examined only the holotype and one other specimen in the Bartlett collection and also one in the Steadman collection. The specimens were collected by the Rev. H. K. Bartlett, L.Th.

KEY TO GENERA OF *ERRONEINAE*.

a. Dorsal blotches not sharply defined.
  b. Margins not spotted.
    c. Cylindrical .. .. *Erronea*
    cc. Elongate cylindrical .. .. *Palangerosa*
  bb. Margins spotted.
    d. Teeth coarse .. .. *Ovatipsa*
    dd. Teeth fine.
      e. Margin narrow.
        f. Spiral bands obscure .. .. *Talostolida*
        ff. Spiral bands defined .. .. *Ipserronea*
      ee. Margin high .. .. *Blasicrura*
aa. Dorsal blotched sharply defined .. .. *Bistolida*

Subfamily ADUSTINAE.

Fifty millimetres in length or less; inflated, pyriform; extremities produced; typically slightly umbilicate; unicoloured, banded or spotted; smooth; teeth medium to coarse, not produced across the base; margin not calloused; base rounded, not spreading. Genera are: *Adusta* Jousseaume, 1884, *Cypraea onyx* Linné, 1758. *Palmadusta* Iredale, 1930, *Cypraea clandestina* Linné, 1758. *Gratiadusta* Iredale, 1930, *Cypraea pyriformis* Gray, 1825. *Solvadusta* Iredale, 1935, *Gratiadusta vaticina* Iredale, 1930. *Notadusta* Schilder, 1935, *Cypraea victoriana* Schilder, 1935. *Zonaria* Jousseaume, 1884, *Cypraea zonaria* Gmelin, 1791, *Albacypraea* gen. nov., *Cypraea eburnea* Barnes, 1828. *Cribraria* Jousseaume, 1884 = *Ocellaria* Weinkauff, 1881, not Ramond, 1801, *Cypraea cribraria* Linné, 1758. *Nivigena* Iredale, 1930, *Nivigena melwardi* Iredale, 1930. *Neobernaya* Schilder 1927, *Cypraea spadicea* Swainson, 1823. *Schilderia* Tomlin, 1930, *Cypraea achatidea* Sowerby, 1837.

Genus ALBACYPRAEA nov.

Genotype: *Cypraea eburnea* Barnes, 1828.

Shell medium size, inflated, pyriform, pure white; extremities produced, very slightly umbilicate; teeth coarse and short, margin not calloused but slightly ridged and crenulate on the outer margin and at both ends of the inner margin; base rounded, not spreading. Length 27–50 mm., width 17–30 mm.

KEY TO GENERA OF *ADUSTINAE*.

a. Rotund.
b. Unicoloured.
c. Brown .. .. *Adusta*
cc. White .. .. *Albacypraea*
bb. Not unicoloured.
d. Blotched, speckled or banded.
e. Rostrate .. .. *Notadusta*
ee. Not rostrate.
f. Blotched and speckled.
g. Large dorsal blotch .. .. *Neobernaya*
gg. Small blotch and speckles.
h. Base rounded .. .. *Solvadusta*
hh. Base less rounded .. .. *Gratiadusta*
ff. Banded .. .. *Palmadusta*
aa. Less rotund.
i. Ocellate .. .. *Cribraria*
ii. Not ocellate.
j. White .. .. *Nivigena*
jj. Coloured.
k. Margins spotted .. .. .. *Zonaria*
kk. Margins not spotted .. .. *Schilderia*

Subfamily NARIINAE.

Twenty millimetres in length or less; ovate, depressed; extremities not or slightly produced; not or slightly umbilicate; speckled, banded, blotched; smooth; teeth fine to medium, not produced across the base; margin not calloused; base flattened but not spreading.

Genera are: *Naria* Broderip, 1837, *Cypraea irrorata* Gray, 1828. *Evenaria* Iredale, 1930, *Cypraea asellus* Linné, 1758. *Melicerona* Iredale, 1930, *Cypraea listeri* Gray, 1828 = *Cypraea melvilli* Hidalgo, 1906. *Paulonaria* Iredale, 1930, *Cypraea beckii* Gaskoin, 1836. Two genera belonging to this subfamily were introduced by Iredale, 1939, and listed in the Zoological Record 1939, 76 as *Cupinota* "gen. nov." (non. descr.) and "*Opponaria*" "gen. nov." (non. descr.). These are synonyms of *Paulonaria* Iredale 1930, diagnosed in our Key.

KEY TO GENERA OF *NARIINAE*.

a. Narrow, subcylindrical, depressed .. .. *Naria*
aa. Wider, cylindrical ovate, depressed. Dotted, banded or spotted.
b. Dotted .. .. *Paulonaria*
bb. Banded or spotted.
c. Banded .. .. *Evenaria*
cc. Spotted and banded .. .. *Melicerona*

Subfamily MAURITIINAE.

One hundred millimetres in length or less; ovate to subcylindrical; extremities not produced; not umbilicate; spotted or with arabic like markings or mozaic patterned; smooth; teeth coarse to medium, not produced across the base; margin calloused; base flattened or spreading. Genera are: *Mauritia* Troschel, 1863, *Cypraea mauritiana* Linné, 1758 = *Maurina* Jousseaume, 1884 = *Mauxiena* Jousseaume, 1884. *Trona* Jousseaume, 1884. *Cypraea stercoraria* Linné, 1758. *Arabica* Jousseaume, 1884, *Cypraea arabica* Linné, 1758. For the Indian Ocean subspecies we use *argiolus* Bolten, 1798, designating Mauritius as the type locality. Bolten briefly but aptly described the species as "*Der Kleine Argus.*"

Cypraea retifera Menke, 1829, is a *nomen nudum*, but *vono* Steadman and Cotton 1943 is available for the Polynesian subspecies.

KEY TO GENERA OF *MAURITIINAE.*

a.	Base well spreading	*Mauritia*
aa.	Base moderately spreading.	
b.	Spotted	*Trona*
bb.	Reticulate	*Arabica*

Subfamily EROSARIINAE.

Forty millimetres in length or less; pyriform to ovate; extremities slightly or not produced; not umbilicate; typically marginally blotched, spotted or peripherally ringed or obscurely banded; smooth or tuberculose; teeth coarse, not produced across the base; margin calloused; base flattened and spreading. Genera are: *Erosaria* Troschel, 1863, *Cypraea erosa* Linné, 1758; *Ravitrona* Iredale, 1930, *Cypraea caputserpentis* Linné, 1758. *Pseudozonaria* Schilder, 1927, *Cypraea arabicula* Lamarck, 1810. *Monetaria* Troschel, 1863, *Cypraea moneta* Linné, 1758 = *Aricia* Broderip, 1837, *Cypraea moneta* Linné, 1758 = *mercatoria* Melvill, 1888. *Ornamentaria* Schilder, 1936, *Cypraea annulus* Linné, 1758. The holotype of *Cypraea kauilani* Kenyon D. 3781 is in the South Australian Museum. It has been considered a variety of *helvola,* but it is Hawaiian subspecies of *erosa.*

KEY TO GENERA OF *EROSARIINAE.*

a.	Spotted colour pattern.	
b.	Extremities slightly produced	*Erosaria*
bb.	Extremities not produced.	
c.	Unicoloured brown margin	*Ravitrona*
cc.	Spotted margin	*Pseudozonaria*
aa.	Not spotted pattern.	
d.	Not peripherally ringed with orange	*Monetaria*
dd.	Peripherally ringed with orange	*Ornamentaria*

Subfamily CYPRAEINAE.

One hundred millimetres in length or less; ovate, inflated; extremities slightly produced; not umbilicate; spotted, banded map-like pattern or unicoloured; smooth; teeth course, not produced across the base; margin not calloused; base rounded. Genera are: *Cypraea* Linné, 1758 = *Porcellana* Humphrey, 1797 (not Jousseaume, 1884) = *Tigris* Troschel, 1863 = *Vulgusella* Jousseaume, 1884, *Cyprаea tigris* Linné, 1758. *Pantherinaria* Sacco, 1894, *Cypraea pantherina* Solander, 1786. *Leporicypraea* Iredale, 1930, *Cypraea mappa* Linné, 1758. *Lyncina* Troschel, 1863, *Cypraea vanelli* Linné, 1758 = *Cypraea lynx* Linné, 1758. *Callistocypraea* Schilder, 1927, *Cypraea aurantium* Gmelin, 1791. *Mystaponda* Iredale, 1930, *Cypraea vitellus* Linné, 1758. *Ponda* Jousseaume, 1884, *Cypraea achatina* Perry, 1811 = *ventriculus* Lamarck, 1810. For *Cypraea leucodon* Broderip, 1828, we designate South Africa as type locality.

KEY TO GENERA OF *CYPRAEINAE.*

a.	Spotted.	
b.	Margin not lined.	
c.	Teeth without red interstices.	
d.	Spots large	*Cypraea*
dd.	Spots small	*Pantherinaria*
cc.	Teeth with red interstices	*Lyncina*
bb.	Margin lined	*Mystaponda*
aa.	Pattern not spotted.	
e.	Pattern map-like	*Leporicypraea*
ee.	Pattern not map-like.	
f.	Unicoloured orange, margin not lined	*Callistocypraea*
ff.	Not unicoloured; margin lined	*Ponda*

Subfamily PUSTULARIINAE.

Pustularia Swainson, 1840. *Cypraea cicercula* Linné, 1758.
cicercula cicercula Linné, 1758, Amboina. 4f. 5c, e. 6c.
cicercula jennisoni Steadman and Cotton, 1943. Fiji. 6d. (pl. 8, fig. 1-3).
cicercula lienardi Jousseaume, 1874. Mauritius. 4a, c.
bistrinotata bistrinotata Schilder and Schilder, 1937. Bismarck Archipelago. 4f. 5a, c.
bistrinotata mediocris Schilder and Schilder, 1938. N. Melanesia. 6c, f. 5e.
bistrinotata sublaevis Schilder and Schilder, 1938. E. Polynesia. 6e, d, h.
globulus globulus Linné, 1758. Amboina. 6c. 5e.
= *margarita* Dillwyn, 1817. Amboina.
= *tricornis* Jousseaume, 1874. Mauritius.
= *affinis* Gmelin, 1791.
globulus sphaeridium Schilder and Schilder, 1938. Central Melanesia. 6c, d, e.
globulus brevirostris Schilder and Schilder, 1938. Seychelles. 4e.
globulus vulavula Steadman and Cotton, 1943. Fiji. 6a, b, c.

Propustularia Schilder, 1927. *Cypraea surinamensis* Perry, 1811.
surinamensis Perry, 1811. Surinam. 2b.
= *bicallosa* Gray, 1831.

Annepona Iredale, 1935. *Pustularia mariae* Schilder, 1927.
mariae Schilder, 1927. Pacific Ocean. 6d, e, h. 5d.
= *annulata* Gray, 1828 *nom. nud.* Pacific Ocean.
theeva Steadman and Cotton, 1943. Fiji. 6d, g. (pl. 9, fig. 7-9).
= *margarita* Gray, 1828, Annaa Island. Not *margarita* Dillwyn, 1817.

Ipsa Jousseaume, 1884 *Cypraea childreni* Gray, 1825.
childreni childreni Gray, 1825. Pacific. 6a, c, d, e, f, h.
childreni lemurica Schilder and Schilder, 1939. Indian Ocean. 4e, f.

Subfamily STAPHYLAEINAE.

Staphylaea Jousseaume, 1884. *Cypraea staphylaea* Linné, 1758.
staphylaea staphylaea Linné, 1758. Mauritius. 4a, b, c, d, e, f.
= *laevigata* Dautzenberg, 1932.
staphylaea consobrina Garrett, 1879. Central Pacific. 6a, b, c, d, e, f, g, h.
descripta descripta Iredale, 1935. Capricorn Group. 6a.
descripta nukulau Steadman and Cotton, 1943. Fiji. 6d.

Purperosa Iredale, 1935. *Purperosa facifer* Iredale, 1935.
facifer facifer Iredale, 1935. Queensland. 6a, b.
facifer monstrans Iredale, 1935. Capricorn Group. 6a.
facifer ruvaya Steadman and Cotton, 1943. Fiji. 6d.
limacina limacina Lamarck, 1810. Amboina (?). 5a, b, c, d, e.
limacina interstincta Wood, 1828. Mauritius (?). 4d, e, f.

Eustaphylaea Steadman and Cotton gen. nov. *Cypraea semiplota* Mighels, 1845.
semiplota Mighels, 1845. Hawaii. 6h.
= *spadix* Mighels, 1845.
= *polita* Roberts, 1868.
= *annae* Roberts, 1869.

Nuclearia Jousseaume, 1884. *Cypraea nucleus* Linné, 1758.
nucleus nucleus Linné, 1758. Amboina. 4f. 5a, b, c, d, e, f. 6a.
nucleus sturanyi Schilder and Schilder, 1939. Red Sea. 4a.
nucleus madagascariensis Gmelin, 1791. Madagascar. 4d, e.
nucleus gemmosa Perry, 1811. Fiji. 6c, d, e, g.
granulata Pease, 1862. Hawaii. 6h.
= *madagascariensis* Sowerby, 1823.
= *honoluluensis* Melvill, 1888.

Subfamily UMBILIINAE.

Umbilia Jousseaume, 1884. *Cypraea umbilicata* Sowerby, 1825.
hesitata hesitata Iredale, 1916. Tasmania. 6b. 5g.
= *umbilicata* Sowerby, 1825. Not Dillwyn, 1823.
hesitata beddomei Schilder, 1930. Port Stephens. 6b.
hesitata howelli Iredale 1931. Bass Straits, 90–150 fathoms. 6b.
hesitata armeniaca Verco, 1912. Eighty miles west of Eucla, 100 fathoms. 5g.

Subfamily ZOILINAE.

Bernaya Jousseaume, 1884. *Cypraea media* Deshayes, 1831 (fossil).
teulerei Cazenavette, 1846. Mocha, Arabia. 4a, b, c, d.
= *leucostoma* Gaskoin, 1843. Not Gmelin, 1790.
= *hidalgoi* Shaw, 1909.
fultoni Sowerby, 1903. Natal. 4c.

Zoila Jousseaume, 1884. *Cypraea friendii* Gray, 1831.
friendii friendii Gray, 1831. Swan River. 5g (Western).
= *scottii* Broderip, 1832.
friendii vercoi Schilder, 1930. Esperance. 5g (Western).
thersites thersites Gaskoin, 1848. South Australia. 5g. (Eastern).
= *marginata* Gaskoin, 1848.
thersites contraria Verco, 1912. Western Australia. 70–100 fathoms. 5g (Central).
thersites venusta Sowerby, 1847. North-Western Australia. 5f.
= *thatcheri* Cox, 1869.
= *bakeri* Gatliff, 1916.
= *brunnea* Cox, 1889. Not Hidalgo.
thersites episema Iredale, 1939. South-Western Australia. 5g.
decipiens Smith, 1880. North-Western Australia. 5f.

Siphocypraea Heilprin, 1887. *Cypraea mus* Linné, 1758.
mus Linné, 1758. Mediterranean. 2b. 3c, d, e.
= *bicornis* Sowerby, 1870.

Subfamily CYPRAEOVULINAE.

Cypraeovula Gray, 1824. *Cypraea capensis* Gray, 1828.
capensis Gray, 1828. South Africa. 4c.
amphithales Melvill, 1888. South Africa. 4c.

Luponia Gray, 1832. *Cypraea algoensis* Gray, 1825.
= *Gaskoinia* Roberts, 1870.
algoensis Gray, 1825. South Africa. 4c.
edentula Gray, 1825. South Africa. 4c.
= *alfredensis* Schilder, 1929.

fuscorubra Shaw, 1909. South Africa. 4c.
= *similis* Gray, 1831. Not Gmelin, 1791.
= *castanea* Higgins, 1868. Not Bolten, 1791.
angustata Gmelin, 1791. South Africa. 4c.
= *fuscodentata* Gray, 1825.
= *coronata* Schilder, 1930.

Notocypraea Schilder, 1927. *Cypraea piperita* Gray, 1825.
piperita Gray, 1825. South Australia. 5g, 6b.
dissecta Iredale, 1931. New South Wales. 6b.
bicolor Gaskoin, 1849. Tasmania. 5g. 6b.
mayi Beddome, 1898. Tasmania. 5g. 6b.
declivis declivis Sowerby, 1870. Tasmania. 5g. 6b.
declivis occidentalis Iredale, 1935. Geographe Bay, Western Australia. 5f.
subcarnea Beddome, 1896. Tasmania. 5g. 6b.
= *albata* Beddome, 1897.
emblema Iredale, 1931. Bass Strait, 70–90 fathoms. 6b.
verconis Cotton and Godfrey, 1932. South Australia. 5g. 6b.

Guttacypraea Iredale, 1935. *Cypraea pulicaria* Reeve, 1846.
pulicaria Reeve, 1846. Western Australia. 5g.
euclia sp. nov. Western Australia, 100 fathoms, 40 miles west of Eucla. 5g. (pl. 11, fig. 4–6).

Thelxinovum Iredale, 1931. *Thelxinovum molleri* Iredale, 1937.
molleri Iredale, 1931. Twofold Bay, New South Wales, 45 fathoms. 6b.

Subfamily AUSTROCYPRAEINAE.

Austrocypraea Cossman, 1903. *Cypraea contusa* McCoy, 1877 (fossil).
= *Prolyncina* Schilder, 1927. *Cypraea reevei* Sowerby, 1832.
reevei Sowerby, 1832. Western Australia. 5g.

Subfamily TALPARIINAE.

Talparia Troschel, 1863. *Cypraea talpa* Linné, 1758.
talpa talpa Linné, 1758. Amboina. 4f. 5a, c. 6a, c, d, e.
talpa saturata Dautzenberg, 1903. Samoa. 6c, d, e, f, g. (pl. 12, fig. 13).
talpa imperialis Schilder and Schilder, 1939. Madagascar. 4a, d, e.
exusta Sowerby, 1832. Gulf of Aden. 4a.

Basilitrona Iredale, 1930. *Cypraea isabella* Linné, 1758.
isabella isabella Linné, 1758. Amboina. 5a, b, c, d, e, f. 6a, b, c.
= *isabella rumphii* Schilder and Schilder, 1939. South Malaysia.
isabella atriceps Schilder and Schilder, 1939. East Polynesia. 6g, h.
isabella lekalekana Ladd, 1934. Tertiary Fossil. Suva.
isabella cavia Steadman and Cotton, 1943. Suva. 6d, e, f.
isabella lemuriana sp. nov. Madagascar. 4a, b, d, e, f.
controversa controversa Gray, 1824. Hawaii. 6f, h.
controversa mexicana Stearns, 1893. Mexico. 2b.
pulchra Gray, 1824. Red Sea. 4a, b.

Luria Jousseaume, 1884. *Cypraea lurida* Linné, 1758.
lurida lurida Linné, 1758. Mediterranean. 3d, e.
lurida minima Dunker, 1853. Cape Verde Is. 3b, c.
lurida oceanica Schilder, 1930. Ascension Is. 3a.

cinerea Gmelin, 1791. Caribbean Sea. 2a, b, c.
= *sordida* Lamarck, 1810.
= *fragiliodes* Hidalgo, 1906.

Chelycypraea Schilder, 1930. *Cypraea testudinaria* Linné, 1758.
testudinaria testudinaria Linné, 1758. Amboina. 5b, e.
testudinaria testudinosa Perry, 1811. Samoa. 6c, d, e, f, g. (pl. 12, fig. 6).
testudinaria ingens Schilder and Schilder, 1939. Mauritius. 4d, e, f.

Arestorides Iredale, 1930. *Cypraea argus* Linné, 1758.
argus argus Linné, 1758. Amboina. 4e. 5a, b, e, f. 6a.
= *argus contrastriata* Perry, 1811. East Indies.
argus ventricosa Gray, 1824. Fiji. 6c, d, e, f, g. (pl. 12, fig. 3).
= *concatenata* Dautzenberg, 1903.

Macrocypraea Schilder, 1930. *Cypraea zebra* Linné, 1758.
zebra zebra Linné, 1758. West Indies. 2a, b.
= *exanthema* Linné, 1767.
zebra dissimilis Schilder, 1924. South-East Brazil. 2c.
cervus cervus Linné, 1771. Florida. 2a, b.
= *cervina* Lamarck, 1822.
cervus peilei Schilder, 1932. Bermuda Island (Pleistocene).
cervinetta Kiener, 1843. Gulf of Panama. 1a, b.

Subfamily ERRONEINAE.

Erronea Troschel, 1863. *Cypraea errones* Linné, 1758.
errones errones Linné, 1758. Amboina. 5b.
= *ovum* Gmelin, 1791.
= *cruenta* Gmelin, 1791.
= *olivacea* Lamarck, 1810.
errones palauensis Schilder and Schilder, 1939. Palau Island. 5d, e.
errones chrysostoma Schilder, 1927. Solomon Islands. 6a, c.
= *sophiae* Brazier, 1875.
errones teramachii Kuroda, 1938. Kii, Japan. 5e.
errones bartletti sp. nov. Rossell Island, New Guinea. 6c. (pl. 11, fig. 1–3).
nimiserrans nimiserrans Iredale, 1935. Queensland. 6a, b. 5f.
nimiserrans kalavo Steadman and Cotton, 1943. Suva. 6d. (pl. 13, fig. 7–9).
nimiserrans vivili Steadman and Cotton, 1943. Suva. 6d. (pl. 9, fig. 4–6).
nimiserrans coerulescens Schröter, 1804. Solomon Islands. 6e, c, g.
nimiserrans coxi Brazier, 1872. Dupuch's Island. North-West Australia. 5f.
nimiserrans bimaculata Gray, 1824. Andaman Islands, 4a, e, f.
= *chrysophaea* Melvill, 1888.
magerrones magerrones Iredale, 1939. Keppel Bay, Queensland, 6a, c.
magerrones proba, Iredale, 1939. North-West Australia. 5f.

Palangerosa Iredale, 1930. *Cypraea cylindrica* Born, 1780.
cylindrica cylindrica Born, 1780. Amboina. 5a, b, c, d, e.
= *subcylindrica* Sowerby, 1870.
cylindrica lenella Iredale, 1939. Michaelmas Cay. 6a, c.
cylindrica sista Iredale, 1939. North-Western Australia. 5f.
cylindrica wangga Steadman and Cotton, 1943. Suva. 6d, e.
cylindrica sowerbyana Schilder, 1932. Ceylon. 4f.

Ovatipsa Iredale, 1931. *Cypraea chinensis* Gmelin, 1791.
chinensis chinensis Gmelin, 1791. China. 5b, d, e.
= *cruenta* Dillwyn, 1817.
= *crenata* Bolten, 1798.
= *morbillosa* Bolten, 1798.
chinensis variolaria Lamarck. Amboina. 4e, f, d. 5a, b, c.
= *violacea* Rous, 1905.
= *tortirostris* Sowerby, 1906.
chinensis sydneyensis Schilder, 1939. Sydney. 6a, b, c, d.
coloba coloba Melvill, 1888. Gulf of Aden. 4a, b.
coloba gregori Ford, 1893. India. 4f.
caurica caurica Linné, 1758. Amboina. 5b, c, d, e.
= *punctulata* Gmelin, 1791.
caurica longior Iredale, 1935. Queensland. 6a.
caurica thema Iredale, 1939. New Caledonia. 6c, d.
= *obscura* Schilder, 1939, not *obscura* Gaskoin.
caurica blaesa Iredale, 1939. North-Western Australia. 5f.
caurica dracaena Born, 1778. India. 4b, d, e, f.
= *corrosa* Gronow, 1781.
= *derosa* Gmelin, 1791.
= *cairnsiana* Melvill Standen, 1904.
caurica quinquefasciata Roding, 1798. Red Sea. 4a.
caurica elongata Perry, 1811. South-East Africa. 4c, d, e.
= *oblongata* Melvill, 1888.

Talostolida Iredale, 1930. *Cypraea teres* Gmelin, 1791.
teres teres Gmelin, 1791. Amboina. 5b.
= *tabescens* Dillwyn, 1817.
= *latior* Melvill, 1888.
teres subfasciata Link, 1807. Mauritius. 4d, e.
= *alveolus* Tapperone, 1882.
teres pentella Iredale, 1939. Lady Elliot Island. 6a, c.
teres pellucens Melvill, 1888. North Pacific. 5e, 6f.
subteres subteres Weinkauff, 1880. South-East Polynesia. 6g.
= *teres* Sowerby, 1832.
subteres hermanni Iredale, 1939. Lady Elliot Island. 6a.
subteres vava Steadman and Cotton, 1943. Suva. 6d.
goodallii goodallii Sowerby, 1832. Lord Hoods Island. 6g.
goodallii fuscomaculata Pease, 1865. Apaiang Island. 6e.
= *adelinae* Roberts, 1885.
= *dautzenbergi* Hidalgo, 1907.
rashleighana rashleighana Melvill, 1888. Loyalty Island. 6c.
rashleighana eunota Taylor, 1916. Hawaii. 6h.

Ipserronea Iredale, 1935. *Ipserronea problematica* Iredale, 1935.
problematica Iredale, 1935. Lindeman Island. 6a.

Blasicrura Iredale, 1930. *Cypraea rhinoceros* Souverbie, 1865.
rhinoceros rhinoceros Souverbie, 1865. New Caledonia. 6a.
rhinoceros vivia Steadman and Cotton, 1943. Suva. 6d.
rhinoceros interrupta Gray. Ceylon. 4f.
irvineanae Cox, 1890. Cape Naturaliste. 5g.
quadrimaculata quadrimaculata Gray, 1824. Amboina. 5b.
= *pallidula* Gaskoin, 1848.
quadrimaculata thielei Schilder and Schilder, 1939. Lindeman Island. 5a, c.

quadrimaculata garretti Schilder and Schilder, 1939. Fiji. 6c, d.
coxeni Cox, 1873. Solomon Islands. 6c.

Bistolida Cossman, 1920. *Cypraea stolida* Linné, 1758.
= *Derstolida* Iredale, 1930. *Derstolida fluctuans* Iredale, 1930.
= *Stolida* Jousseaume, 1884, not Lesson, 1831.
stolida stolida Linné, 1758. Ceylon. 4f.
stolida thakau Steadman and Cotton, 1943. Suva. 6d. (pl. 10, fig. 1–3).
stolida crossei Marie, 1869. New Caledonia. 6c.
stolida diauges Melvill, 1888. Natal. 4e.
stolida brevidentata Sowerby, 1870. Borneo. 5d.
= *moniontha* Melvill, 1888.
stolida erythraeensis Sowerby, 1837. Red Sea. 4a.
fluctuans fluctuans Iredale, 1935. Lindeman Island. 6a.
fluctuans deceptor Iredale, 1935. Torres Strait. 6a.

Subfamily ADUSTINAE.

Adusta Jousseaume, 1884. *Cypraea onyx* Linné, 1758.
onyx onyx Linné, 1758. Amboina*. 5b, c, d, e.
onyx melanesiae Schilder and Schilder, 1937. New Britain. 6c
onyx nymphae Jay, 1850. Mauritius. 4e.
= *carnicolor* Mörch, 1852.
onyx succincta Linné, 1758. Ceylon*. 4f.
= *umbilicata* Dillwyn, 1823.
onyx persica Schilder and Schilder, 1939. Persian Gulf. Fao. 4b.
onyx adusta Lamarck, 1880. Zanzibar*. 4d.

Palmadusta Iredale, 1930. *Cypraea clandestina* Linné, 1758.
clandestina clandestina Linné, 1767. Ceylon. 4a, b, e, f.
clandestina passerina Melvill, 1888. South East Africa 4d, e.
clandestina moniliaris Lamarck, 1810. South Malaysia. 5b, c, d.
clandestina candida Pease, 1865. Central Pacific. 6d, g.
clandestina whitleyi Iredale, 1939. Michaelmas Cay. 5f, 6b.
clandestina extrema Iredale, 1939. Shell harbour, New South Wales. 6a, b.
clandestina artuffeli Jousseaume, 1876. Japan. 5e.
saulae saulae Gaskoin, 1843. Philippine Islands. 5c, e.
saulae nugata Iredale, 1935. Lindeman Island. 6a.
contaminata contaminata Sowerby, 1832. Amboina. 5b, c, d, e. 6c.
contaminata distans Schilder and Schilder, 1939. Natal. 4d, e.
lutea lutea Grunov, 1781. Ceylon. 4f.
= *commixta* Wood, 1828.
lutea humphreysii Gray, 1825. Amboina. 5a, b, c, d, e. 6a, b.
= *nivea* Wood, 1828.
lutea yaloka Steadman and Cotton, 1943. Suva, Fiji. 6d.
lutea bizonata Iredale, 1935. Nickol Bay, North-West Australia. 5f.
ziczac ziczac Linné, 1758. Amboina. 5b, c, d, e.
= *vittata* Deshayes, 1831.
ziczac undata Lamarck, 1810. Ceylon. 4f. 5a.
ziczac misella Perry, 1811. East Africa*. 4d.
ziczac signata Iredale, 1939. Clarence River, New South Wales. 6a, b.
ziczac diluculum Reeve, 1845. Natal. 4c, d
= *undata* Lamarck, 1822.
ziczac virginalis Schilder and Schilder, 1939. Seychelles. 4e.
= *buttoni* Oldroyd, 1916.

Gratiadusta Iredale, 1930. *Cypraea pyriformis* Gray, 1825.
pyriformis pyriformis Gray, 1825. Ceylon. 4f. 5a, f. 6a.
pyriformis smithi Sowerby, 1881. North West Australia. 5f.
kaiseri Kenyon, 1897. Lagrange Bay. 5f. 6a.
walkeri walkeri Sowerby, 1832. Persian Gulf. 4b, e. 6a.
= *amabilis* Jousseaume, 1881.
walkeri continens Iredale, 1935. Lindeman Island. 6a.
walkeri comptonii Gray, 1847. Pt. Essington, North Australia. 5f.
walkeri bregeriana Crosse, 1868. New Caledonia. 6c.
walkeri merista Iredale, 1939. Whitsunday Group, Queensland. 6a.
walkeri surabajensis Schilder, 1937. Surabaya. 5b, c, d.
xanthodon Sowerby, 1832. Keppel Bay, Queensland*. 6a, b.
vredenburgi Schilder, 1927. Nusa Kambangan, South-West Java. 5c, b.
pallida pallida Gray, 1824. Bombay. 4b, f.
pallida insulicola Schilder and Schilder, 1939. Batavia. 5b, c, d, e.
pulchella pulchella Swainson, 1823. China. 5d, e.
pulchella novaebritanniae Schilder and Schilder, 1937. New Britain. 6c.
pulchella vayssièrei Schilder and Schilder, 1939. Gulf of Aden. 4a.
pulchella pericalles Melvill and Standen, 1904. Gulf of Oman. 4b.
hungerfordi Sowerby, 1888. Japan. 5e.
= *kiiensis* Roberts, 1913.
langfordi Kuroda, 1938. Okinosima, Tosa, Japan. 5e.
barclayi Reeve, 1857. Mauritius. 4e.
hirasei Roberts, 1930. Japan. 5e.

Solvadusta Iredale, 1935. *Gratiadusta vaticina* Iredale, 1930.
subviridis vaticina Iredale 1930. Sydney Harbour. 6a, b.
subviridis subviridis Reeve 1835. North Queensland. 5f. 6a.
= *dorsalis* Schilder and Schilder, 1938.
subviridis kesata Steadman and Cotton, 1943. Suva. 6d.
subviridis anceyi Vayssiere, 1905. New Caledonia. 6c.
subviridis jensostergaardi Ingram, 1939. Koror Island. Palau Group, Caroline Islands. 5d. 6f.

Notadusta Schilder, 1935. *Notodusta victoriana* Schilder, 1935 (fossil).
martini martini Schepman, 1907. N.W. Celebes. 5b, d.
martini superstes Schilder, 1930. New Hebrides. 6c.

Albacypraea Cotton and Steadman gen. nov. *Cypraea eburnea* Barnes, 1828.
eburnea eburnea Barnes, 1828. Fiji. 6d. (pl. 12, fig. 11; pl. 13, fig. 10–13).
eburnea mara Iredale, 1939. New Caledonia. 5d. 6a, c.

Neobernaya Schilder, 1927. *Cypraea spadicea* Swainson, 1823.
spadicea Swainson, 1823. California. 1a.

Cribraria Jousseaume, 1884. *Cypraea cribraria* Linné, 1758.
cribraria cribraria Linné, 1758. Ceylon. 4f.
cribraria northi Steadman and Cotton, 1943. Nadroga, Fiji. 6c, d. (pl. 11, fig. 7–9).
cribraria zadela Iredale, 1939. Hamilton Island, Whitsunday Group, Queensland. 6a, c.
cribraria fallax Smith, 1881. West Australia. 5f, g.
cribraria exmouthensis Melvill, 1888. West Australia, Exmouth Gulf. 5f.
cribraria comma Perry, 1811. S.E. Africa. 4c, d, e.
cribellum Gaskoin, 1849. Mauritius. 4e.
esontropia Duclos, 1833. Mauritius. 4e.
= *translucida* Melvill, 1888.

catholicorum Schilder and Schilder, 1938. Melanesia. 6c.
= *fischeri* Schilder, 1933.
gaskoini Reeve, 1846. Sandwich Islands. 6h.
= *peasei* Sowerby, 1870.
= *fischeri* Vayssiere, 1910.
cumingii cumingii Sowerby, 1832. Tahiti. 6d.
= *compta* Pease, 1860.
cumingii cleopatra Schilder and Schilder, 1938. South-East Polynesia. 6g.

Nivigena Iredale, 1930. *Nivigena melwardi* Iredale, 1930.
melwardi Iredale, 1930. North-West Islet, Capricorn Group. 6a.

Zonaria Jousseaume, 1884. *Cypraea zonaria* Gmelin, 1791.
zonaria Gmelin, 1791. Guinea. 3b.
= *zonata* Lamarck, 1810.
gambiensis Shaw, 1909. Cape Verd. 3b, c.
= *nebulosa* Kiener, 1843.
picta Gray, 1824. Cape Verd. 3b, c.
= *atava* Rochebrune, 1884.
annettae annettae Dall, 1909. Gulf of California. 1a, b.
= *sowerbyi* Kiener, 1845.
annettae aequinoctialis Schilder, 1933. North Peru. 1c.
sanguinolenta Gmelin, 1791. Cape Verd. 3b, c.
petitiana Crosse, 1872. Cape Verd. 3b, c.
pyrum pyrum Gmelin, 1791. South Europe. 3e
= *cinnamomaea* Olivi, 1792.
= *rufa* Lamarck, 1810.
pyrum senegalensis Schilder, 1928. Cape Verd. 3b, c.
pyrum angolensis Odhner, 1923. S. Angola. 3a, b.
pyrum insularum Schilder, 1928. North-West Africa. 3c.
pyrum maculosa Gmelin, 1791. North Coast of Africa. 3d.

Schilderia Tomlin, 1930. *Cypraea achatidea* Sowerby, 1837.
achatidea achatidea Sowerby, 1837. Sicily. 3e.
= *grayi* Kiener, 1843
= *physis* Deshayes, 1844.
achatidea oranica Crosse, 1896. Oran. 3d.
achatidea inopinata Schilder, 1930. West Africa. 3c.
achatidea longinqua Schilder and Schilder, 1939. S. Angola. 3b.

Subfamily NARIINAE.

Naria Broderip, 1837. *Cypraea irrorata* Gray, 1828.
irrorata Gray, 1828. Polynesia. 6d, e, f, g.

Paulonaria Iredale, 1930. *Cypraea beckii* Gaskoin, 1836.
= *Opponaria* Iredale, 1939.
= *Cupinota* Iredale, 1939.
beckii Gaskoin, 1836. Philippine Islands. 5d. 6a, c, e, f.
dillwyni Schilder, 1932. E. Polynesia. 6g.
macandrewi Sowerby, 1870. Red Sea. 4a.
= *thomasi* Crosse, 1865.
microdon microdon Gray, 1828. Philippine Islands. 5d. 6a, c.
= *katha* Iredale, 1939.
= *microdon* Sowerby, 1832.
= *fimbriata* Garrett, 1879. Not Gmelin, 1791.
= *minoridens* Melvill, 1901.

microdon granum Schilder and Schilder, 1939. Fiji. 6d, e.
microcodon chrysalis Kiener, 1843. Mauritius. 4e.
waikikiensis Schilder and Schilder, 1933. Waikiki. 6h.
serrulifera Schilder and Schilder, 1938. Huahine Island. 6g.
fimbriata fimbriata Gmelin, 1791. Mauritius. 4e.
fimbriata durbanensis Schilder and Schilder, 1939. Durban. 4c, d.
fimbriata marmorata Schröter, 1804. East Malaysia. 5b, c, d, e. 6a, b, c.
fimbriata unifasciata Mighels, 1845. Polynesia. 6g.
fimbriata suvaensis Steadman and Cotton, 1943. Suva. 6d, e. (pl. 9, fig. 1–3).
fimbriata blandita Iredale, 1939. Port Jackson. 6b.
macula macula Angas, 1867. Port Jackson. 6b.
= *irescens* Sowerby, 1870.
= *interpunctata* Henn, 1896.
macula hammondae Iredale, 1939. Clarence River. 6b.
macula cholmondeleyi Melvill, 1888. Australia. 6a.
macula hilda Iredale, 1939. Sharks Bay. 5f.
gracilis gracilis Gaskoin, 1848. Central Malaysia. 5a, c, f.
gracilis notata Gill, 1858. Red Sea. 4a, b.
= *subcoerulea* Schilder and Schilder, 1931.
gracilis japonica Schilder, 1931. Japan. 5e.

Evenaria Iredale, 1930. *Cypraea asellus* Linné, 1758.
asellus asellus Linné, 1758. Amboina. 4e, f. 5a, b, c, d.
= *vespacea* Melvill, 1905.
asellus bitaeniata Geret, 1903. Queensland. 6a, b.
= *latefasciata* Schilder, 1930.
asellus kawakawa Steadman and Cotton, 1943. Suva. 6d, e, g.
punctata punctata Linné, 1758. Mauritius. 4a, d, e, f.
= *stercusmuscarium* Lamarck, 1810.
punctata atomaria Gmelin, 1791. Amboina, 5a, b, c, d, e.
punctata iredalei Schilder and Schilder, 1939. Lindeman Is. 6a, b, c.
punctata persticta Iredale, 1939. Michaelmas Cay. Queensland. 6a.
punctata trizonata Sowerby, 1870. E. Polynesia. 6d, g.
punctata carula Iredale, 1939. Yirrkala, Arnhem Land, Gulf of Carpentaria. 5f.
ursellus ursellus Gmelin, 1791. Madagascar. 4d.
= *kieneri* Hidalgo, 1906.
= *hirundo* Sowerby, 1837.
= *owenii* Sowerby, 1837. Mauritius.
= *menkeana* Deshayes, 1863.
= *modesta* Sowerby, 1870.
= *vasta* Schilder and Schilder, 1939. South Africa.
ursellus depriesteri Schilder, 1933. S. Malaysia. 5a, b, c, d.
ursellus schneideri Schilder and Schilder, 1939. New Britain. 6c.
ursellus vitiensis Steadman and Cotton, 1943. Suva, Fiji. 6d, g. (pl. 8, fig. 4–6).
ursellus marcia Iredale, 1939. New South Wales. 6a, b.
reductesignata Schilder, 1924. Seychelles. 4e.
hirundo hirundo Linné, 1758. Ceylon. 4f.
hirundo neglecta Sowerby, 1837. Central Malaysia. 5a, b, c, d.
hirundo rouxi Ancey, 1882. Melanesia 6c.
hirundo korolevu Steadman and Cotton, 1943. Korolevu, Fiji. 6d, g. (pl. 8, fig. 7–9).
hirundo cameroni Iredale, 1939. North Australia. 5f. 6a, b.

hirundo peropima Iredale, 1939. North West Islet. 6a.
hirundo francisca Schilder and Schilder, 1939. Seychelles. 4c.
coffea coffea Sowerby, 1870. Borneo. 5d.
coffea amoeba Schilder and Schilder, 1939. Aitape, New Guinea. 6c.
coffea endela Iredale, 1939. Michaelmas Cay, Queensland. 6a.

Melicerona Iredale, 1930. *Cypraea listeri* Gray, 1824.
felina felina Gmelin, 1791. South Africa. 4d, e.
felina listeri Gray, 1824. Maldive. 4f.
= *ursellus* Kiener, 1843.
felina melvilli Hidalgo, 1906. Amboina. 5a, b, c, d.
felina velesia Iredale, 1939. Clarence River, New South Wales. 6a, b.
felina vatu Steadman and Cotton, 1943. Suva, Fiji. 6d, g.
felina pauciguttata Hirase, 1934. Japan. 5e.
felina fabula Kiener, 1843. South-East Arabia. 4a, b.
lentiginosa Gray, 1825. Ceylon. 4b, f.

Subfamily MAURITIINAE.

Mauritia Troschel, 1863. *Cypraea mauritiana* Linné, 1758.
mauritiana mauritiana Linné, 1758. Mauritius. 4d, e, f.
mauritiana regina Gmelin, 1791. West Malaysia. 5a, b, c, d, f,
mauritiana calxequina Melvill and Standen, 1899. Central Pacific, 6a, c, d, e, g (pl. 12, fig. 12).

Trona Jousseaume, 1884. *Cypraea stercoraria* Linné, 1758.
stercoraria Linné, 1758. Gulf of Guinea. 3b.
= *conspurcata* Gmelin, 1791.
= *rattus* Lamarck, 1810.

Arabica Jousseaume, 1884. *Cypraea arabica* Linné, 1758.
arabica arabica Linné, 1758. Straits of Sunda. 5a, b, c.
= *intermedia* Gray, 1824.
arabica asiatica Schilder and Schilder, 1939. Formosa. 5d, e.
arabica westralis Iredale, 1935. Western Australia. 5f. 6a.
arabica dilacerata Schilder and Schilder. Bay of Bengal. 4f.
arabica imamis Schilder and Schilder. Madagascar. 4e.
arabica histrio Gmelin, 1791. Friendly Islands. 6c, d, e, g. (pl. 12, fig. 1).
= *arlequina* Mörch, 1852.
= *reticulata* Martyn, 1784. (not binomial).
=*maculifera* Schilder, 1932.
eglantina eglantina Duclos, 1833. ("California", error) Polynesia 6g.
eglantina momokiti Steadman and Cotton, 1943. Suva, Fiji. 6c, d, e.
eglantina couturieri Vayssière, 1905. Philippine Islands. 5b, c, d.
eglantina perconfusa Iredale, 1935. Western Australia. 5f. 6a.
eglantina grayana Schilder, 1930. Red Sea. 4b, e, f.
eglantina niger Roberts, 1885. New Caledonia.
scurra scurra Gmelin, 1791. Amboina. 5a, b, c, d, f. 6a.
= *indica* Gmelin, 1791.
= *amarata* Mörch, 1852.
scurra argiolus Bolten, 1798. Mauritius. 4e, f.
= *indica* Sowerby, 1836.
scurra antelia Iredale, 1939. Lady Elliot Island, Queensland. 6a.
scurra vono Steadman and Cotton, 1943. Suva, Fiji. 6c, d.
= *retifera* Menke, 1829. *Nom nud*, 1829.

depressa depressa Gray, 1824. Central Pacific. 5f. 6a, c, d, e, f, g. (pl. 12, fig. 5).
= *intermedia* Redfield, 1847.
= *gillei* Jousseaume, 1893.
depressa dispersa Schilder and Schilder, 1939. Indian Ocean. 4a, f.

Subfamily EROSARIINAE.

Erosaria Troschel, 1863. *Cypraea erosa* Linné, 1758.
erosa erosa Linné, 1758. Mauritius. 4e, f.
= *similis* Gmelin, 1791.
= *subalba* Smith, 1912.
= *miliaris* Gmelin, 1791.
erosa phagedaina Melvill, 1888. Central Malaysia. 5a, b, c, d, e, f, g, h.
erosa chlorizans Melvill, 1888. Central Melanesia. 6c, d, e, f. (pl. 13, fig. 1–3).
= *lactescens* Dautzenberg-Bouge, 1933.
erosa kauilani Kenyon, 1900. Hawaii. 6h.
erosa purissima Vredenburg, 1919. Queensland. 6a, b.
nebrites nebrites Melvill, 1888. Red Sea. 4a, b.
nebrites ceylonica Schilder and Schilder, 1939. India. 4f.
nebrites mozambicana Schilder and Schilder, 1939. South-East Africa. 4d.
ocellata Linné, 1758. Ceylon. 4a, b, e, f.
marginalis marginalis Dillwyn, 1817. South-East Africa. 4c, d.
= *listeri* Gray, 1825.
marginalis pseudocellata Schilder and Schilder, 1939. South-East Arabia. 4a.
inocellata inocellata Gray, 1825. Japan. 5e.
inocellata diversa Kenyon, 1902. Sharks Bay. 5f.
inocellata metavona Iredale, 1935. Queensland. 6a, b.
inocellata differens Schilder, 1927. Central Malaysia. 5a, b, c, d.
= *brevis* Smith, 1913, preoccupied.
= *effossa* Schilder, 1937.
lamarckii lamarckii Gray, 1825. South-East Africa. 4d, c.
lamarckii redimita Melvill, 1888. Gulf of Bengal. 4e, f.
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= *brocktoni* Iredale, 1930.
turdus turdus Lamarck, 1810. Southern Red Sea. 4a.
= *ovata* Perry, 1811.
= *distinguenda* Schilder, 1927.
turdus pardalina Dunker, 1852. Gulf of Suez. 4a.
= *pyriformis* Sowerby, 1870.
turdus zanzibarica Sullioti, 1911. South East Africa. 4d.
turdus winckworthi Iredale, 1939. Gulf of Oman. 4b.

Ravitrona Iredale, 1930. *Cypraea caputserpentis* Linné, 1758.
caputserpentis caputserpentis Linné, 1758. Mauritius. 4d, e, f.
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= *caputophidii* Schilder, 1927.
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= *caputcolubri* Kenyon, 1898.

caputdraconis Melvill, 1888. Easter Island. 6g.
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= ? *flaveola* Linné, 1758. Unidentifiable.
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= *punctulata* Gray, 1824.
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= *tuberculosa* Quoy and Gaimard, 1834.
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= *moneta erua* Steadman and Cotton, 1943.
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= *ethnographica* Rochebrune, 1884.
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= *sosokoana* Ladd, 1934.
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= *perrieri* Rochebrune, 1884.

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Cypraea Linné, 1758. *Cypraea tigris* Linné, 1758.
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= *pardalis* Shaw, 1795.
= *lyncichroa* Melvill, 1888.
tigris volai Steadman and Cotton, 1943. Suva, Fiji. 6a, c, d, e, f, g, h. (pl. 12, fig. 2).
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Pantherinaria Sacco, 1890. *Cypraea pantherina* Solander, 1786.
pantherina Solander, 1786. Red Sea. 4a.
= *vinosa* Gmelin, 1791.
= *obtusa* Perry, 1811.
= *tigrina* Lamarck, 1822.
= *catulus* Schilder, 1924.

Lyncina Troschel, 1863. *Cypraea lynx* Linné, 1758.
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= *michaelis* Melvill, 1905.
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Mystaponda Iredale, 1930. *Cypraea vitellus* Linné, 1758.
vitellus vitellus Linné, 1758. Sunda, Asia. 5a, b, c, d, e, f.
= *distorta* Cox, 1889, preoccupied.
vitellus polynesiae Schilder and Schilder, 1939. Fiji. 6c, d, e, f, g, h. (pl. 12, fig. 7).
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= *vitellus sarcodes* Melville, 1888.
vitellus orcina Iredale, 1931. Sydney Harbour. 6a, b.
camelopardalis Perry, 1811. Red Sea. 4a.
= *melanostoma* Sowerby, 1825.

nivosa Broderip, 1827. Mauritius. 4e, f.
= *dama* Gray, 1828.
broderipii Sowerby, 1832. Madagascar. 4d, e.
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Leporicypraea Iredale, 1930. *Cypraea mappa* Linné, 1758.
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= *geographica* Schilder and Schilder, 1933.
mappa viridis Kenyon, 1902. 6c.
mappa rewa, Steadman and Cotton, 1943. Suva, Fiji. 6d, e, g. (pl. 12, fig. 10).
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= *rosea* Gray, 1824.
= *subsignata* Melvill, 1888.
valentia Perry, 1811. Amboina. 5b.
= *princeps* Gray, 1824.

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ventriculus ventriculus Lamarck, 1810. Annaa Island. 6g, h.
= *achatina* Perry, 1811.
ventriculus topee Steadman and Cotton, 1943. Kadavu, Fiji. 6c, d, e. (pl. 12, fig. 8).
carneola carneola Linné, 1758. Amboina. 5b, c, d, e.
carneola propinqua Garret, 1879. Paumota Islands. 6c, d, e, f, g, h. (pl. 12, fig. 14).
= *leviathan* Schilder and Schilder, 1937.
carneola thepalea Iredale, 1939. New South Wales. 6a, b.
carneola sowerbyi Anton, 1839. Mauritius. 4e, f. 5a, f.
= *loebbeckeana* Weinkauff, 1881.
carneola crassa Gmelin, 1791. Red Sea. 4a.
sulcidentata Gray, 1824. Hawaii. 6h.
schilderorum Iredale, 1939. Annaa Island. 6d, e, g, h.
= *arenosa* Gray, 1824. Not Dillwyn, 1823.
tessellata Swainson, 1822. Hawaii. 6h.

SUMMARY.

The Cypraeidae may be arranged into thirteen subfamilies, and sixty-one genera. The species numbering about one hundred and seventy are mostly readily formed into a complex of subspecies inhabiting definite geographical regions.

It is hoped that this work will stabilize the nomenclature and solve some problems associated with the family Cypraeidae.

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Steadman and Cotton (1943, December): *S. Aust. Nat.*, 22, No. 2, pp. 15–18.

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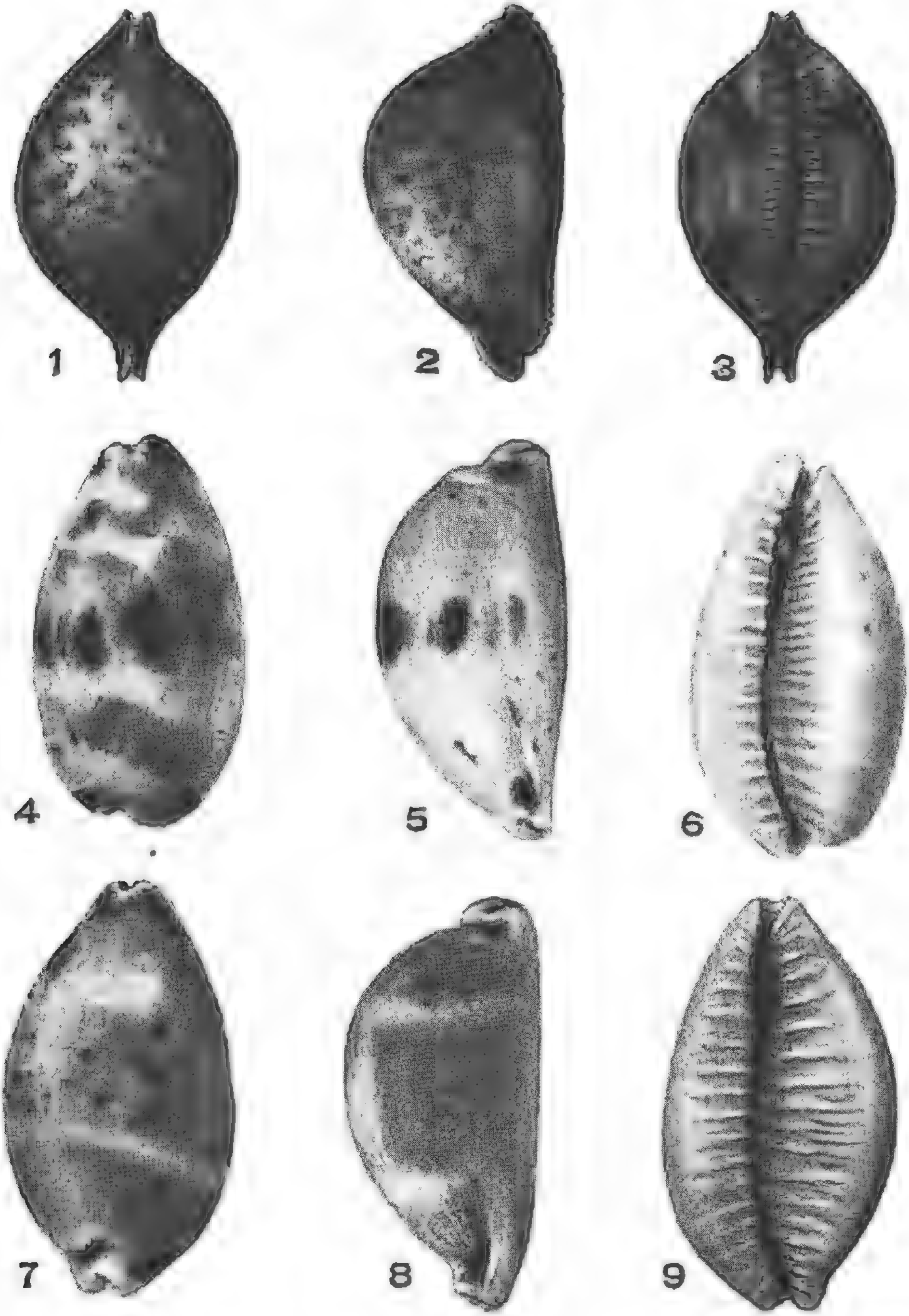

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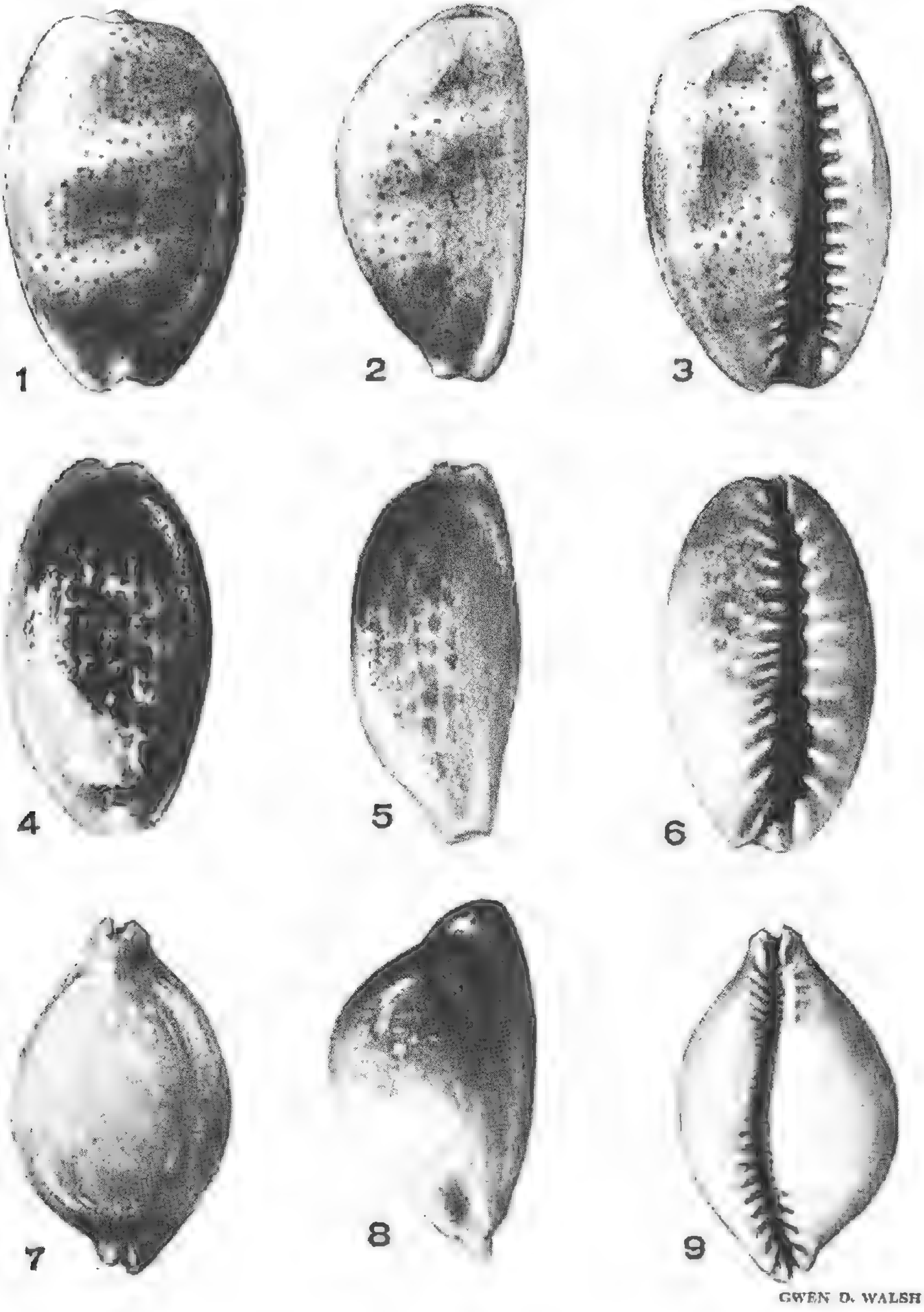
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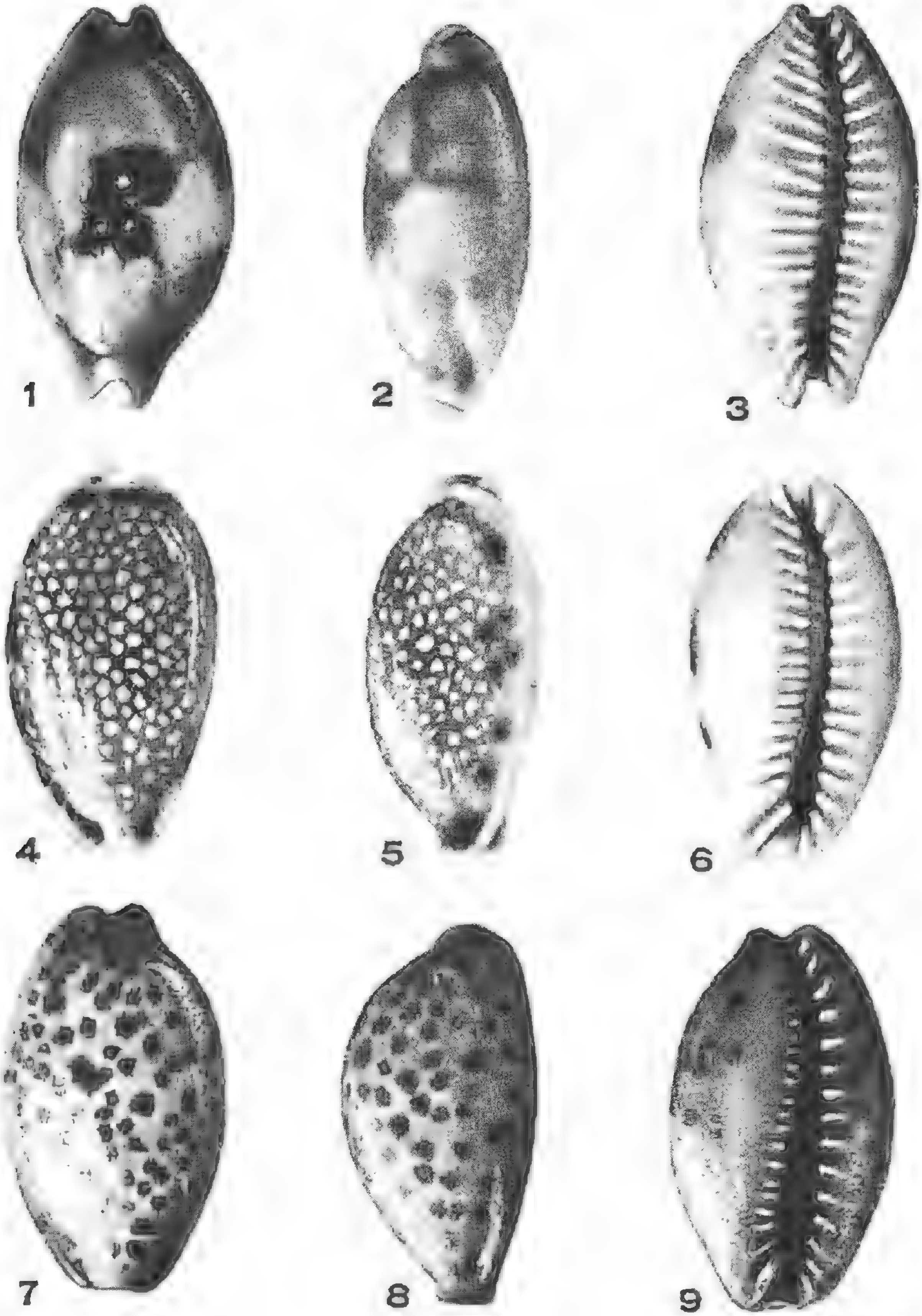

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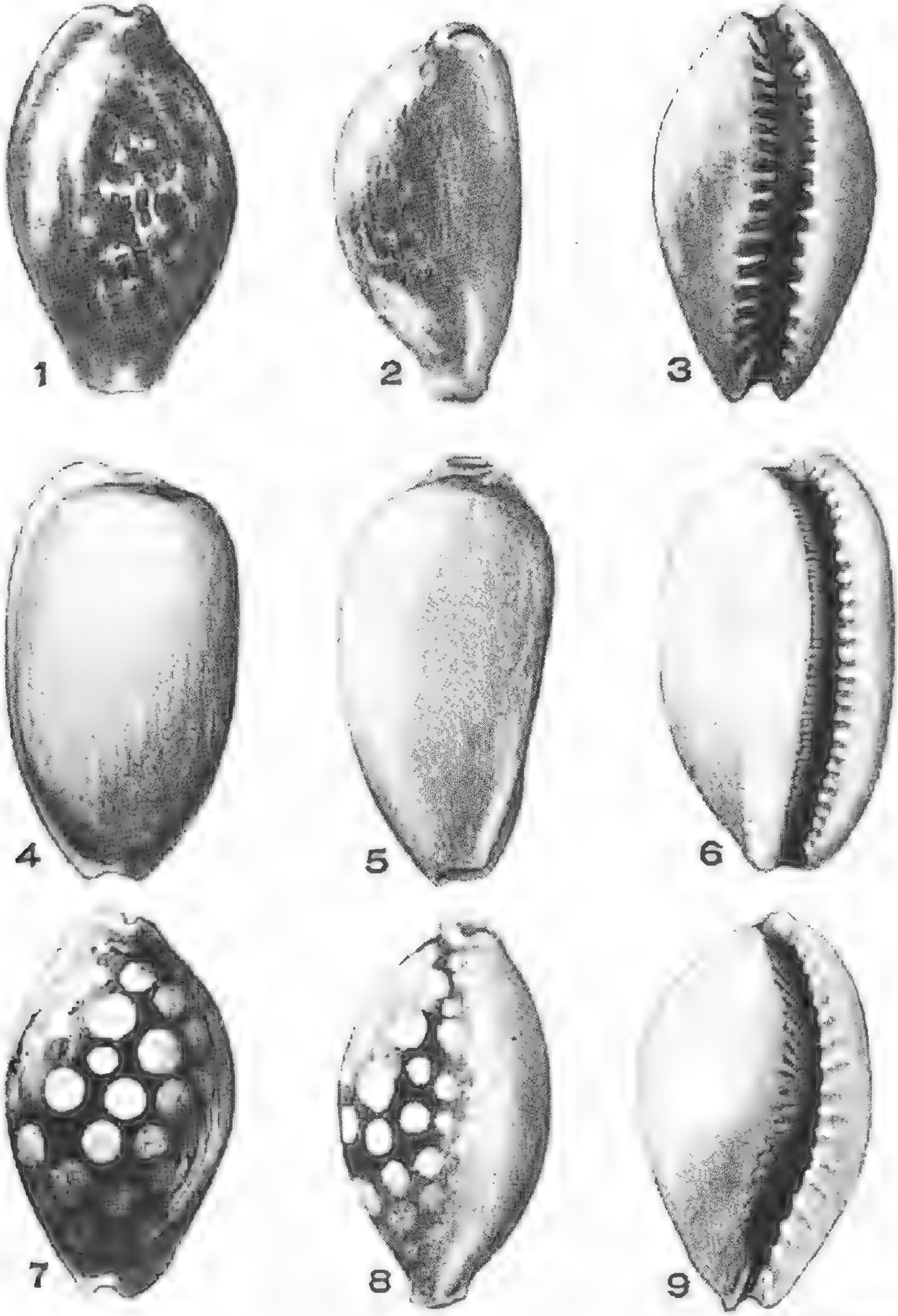
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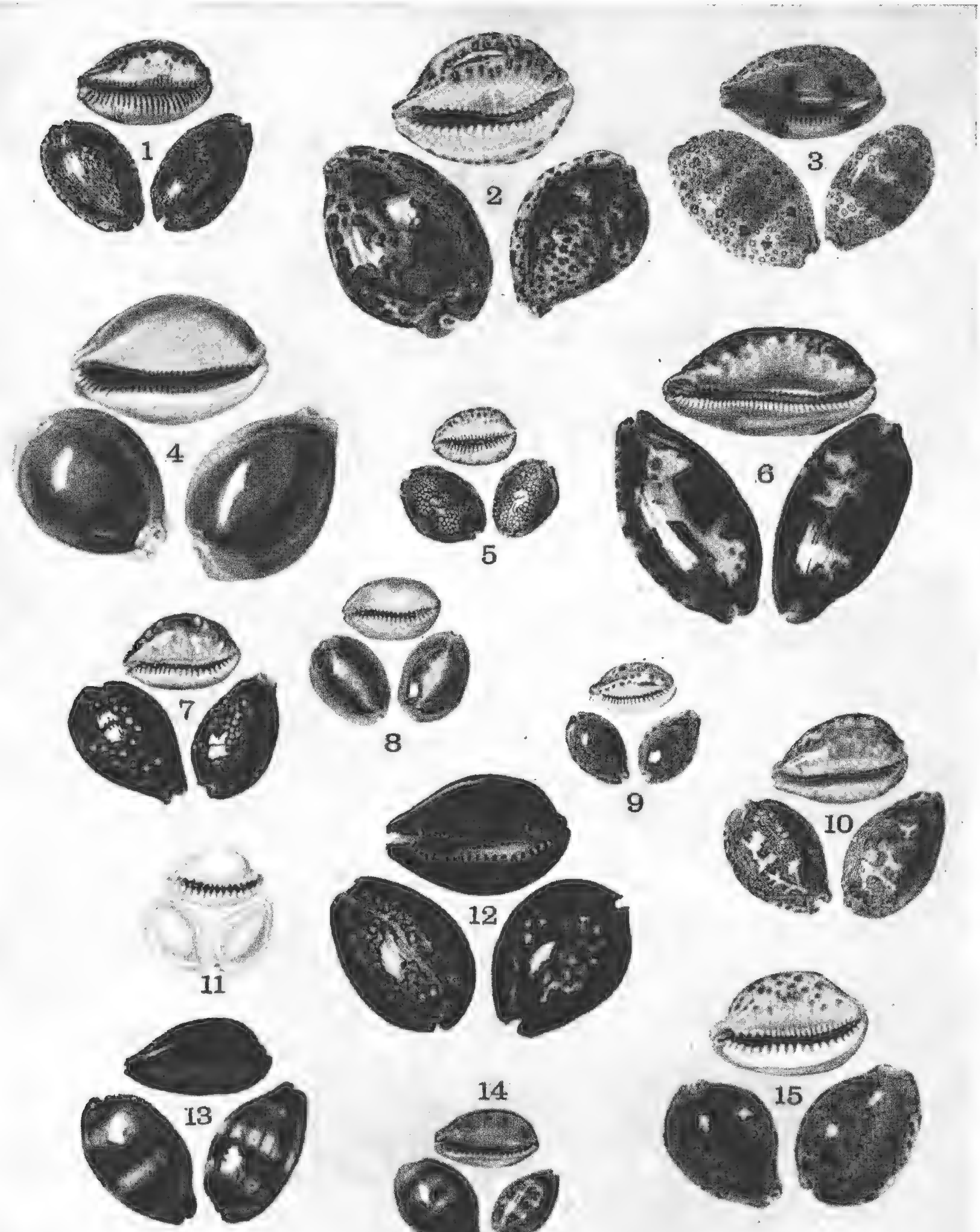
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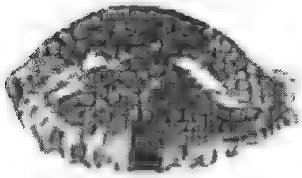
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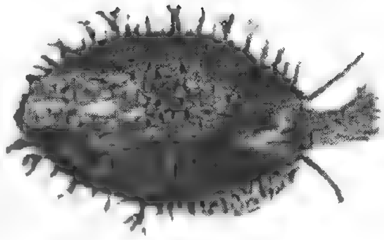
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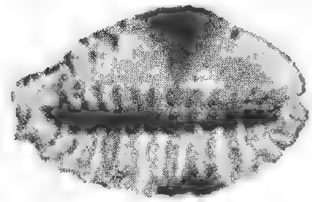
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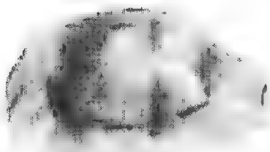
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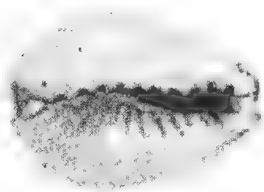
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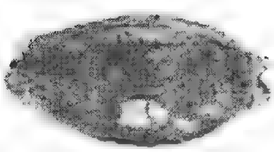
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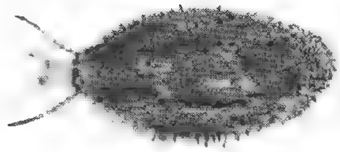
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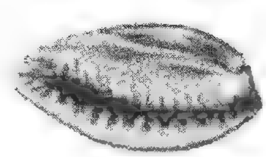
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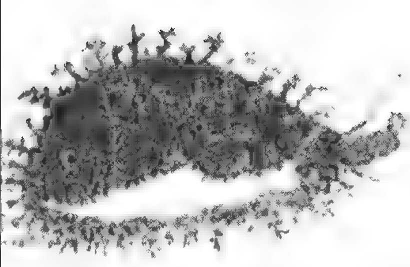
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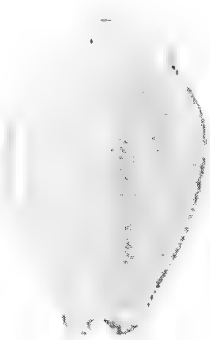
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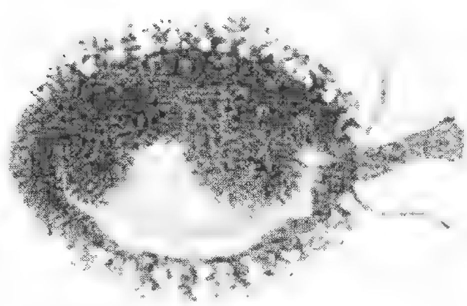
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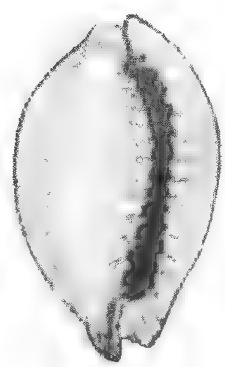
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RECORDS

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THE PIGMY SPERM WHALE (KOGIA BREVICEPS, BLAINVILLE) ON SOUTH AUSTRALIAN COASTS

By Herbert M. Hale, Director, South Australian Museum

Summary

It is now possible to list three localities at which the Pigmy, or Short-headed Sperm Whale (Kogia breviceps) has been taken in South Australia.
The first record of the species on the coast of this State is furnished by Wood Jones (1925, p. 279) who notes a lower jaw secured at Encounter Bay about 1885.

THE PIGMY SPERM WHALE (*KOGIA BREVICEPS*, BLAINVILLE) ON SOUTH AUSTRALIAN COASTS

By HERBERT M. HALE, Director, South Australian Museum.

Plates xiv–xviii and Text Fig. 1–17.

It is now possible to list three localities at which the Pigmy, or Short-headed, Sperm Whale (*Kogia breviceps*) has been taken in South Australia.

The first record of the species on the coast of this State is furnished by Wood Jones (1925, p. 279) who notes a lower jaw secured at Encounter Bay about 1885.

The Pigmy Sperm Whale was not noticed again in South Australia until April 25, 1937, when a mature female was stranded alive at Port Victoria, in Spencer Gulf. At the same time a smaller example, which was seen to be accompanying the adult prior to her misfortune, was observed swimming close inshore, and later on the same date this individual—which proved to be a young female—also was cast up on to the beach. Thanks to the efforts of Mr. H. E. A. Edwardes, of Port Victoria, both specimens were secured, carried over some cliffs and transported to the South Australian Museum, where measurements were made and casts and skeletons prepared. The calf was evidently still suckling at the time, for the mammary glands were active in the mother; the uterus of the last-named contained a foetus about 20 cm. in length. A brief record of this occurrence was made by the writer (1939, p. 7) and some further details of the three specimens are given herein.

Thirdly, in August, 1944, Miss N. M. Follett furnished a description and a drawing of a "large fish 7 to 8 feet in length" which had come ashore in the vicinity of Sleaford Bay, near Port Lincoln. Miss Follett's excellent account showed it to be a *Kogia*. Recovery of this material proved even more difficult than in the case of the Port Victoria examples and necessitated a journey of sixteen miles over a rough track and then the crossing of a mile or so of high sandhills. Finally, a month after the stranding, the skull and some other bones were collected for the Museum.

It should be noted that the plaster casts of the Port Victoria female and calf now exhibited in the South Australian Museum are of one side only and are not necessarily accurate in regard to measurements, as the contour does not occur along a truly sagittal section. Furthermore, the pectoral limbs were removed

by the preparators before moulding thus resulting in slight distortion in their region.

I am indebted to Miss Gwen D. Walsh for preparation of most of the drawings and photographs illustrating this paper.

NOTES ON EXTERIOR OF ADULTS AND CALF.

The colour of both cow and calf from Port Victoria was jet black above and on the sides, fading into the white of the underside from back of the mouth to a little posterior to the anus. Miss Follett describes the Sleaford Bay example as blackish brown above and reddish below but this difference in colouration may have been due to post-mortem changes.

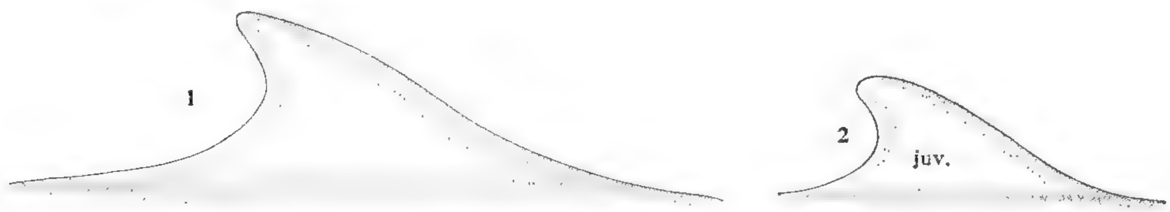

Fig. 1–2. Dorsal fins of adult female and calf from Port Victoria (1/5 nat. size).

Scale drawings of the cow and calf from Port Victoria are reproduced on Plate xiv. In size this adult female approaches the largest of the five definitely breeding females previously recorded (Allen, 1941, pp. 24–25).

The body is less than four times as long as greatest depth. The snout is deep and blunt, and in front of the mandible it curves forwards and upwards for a short

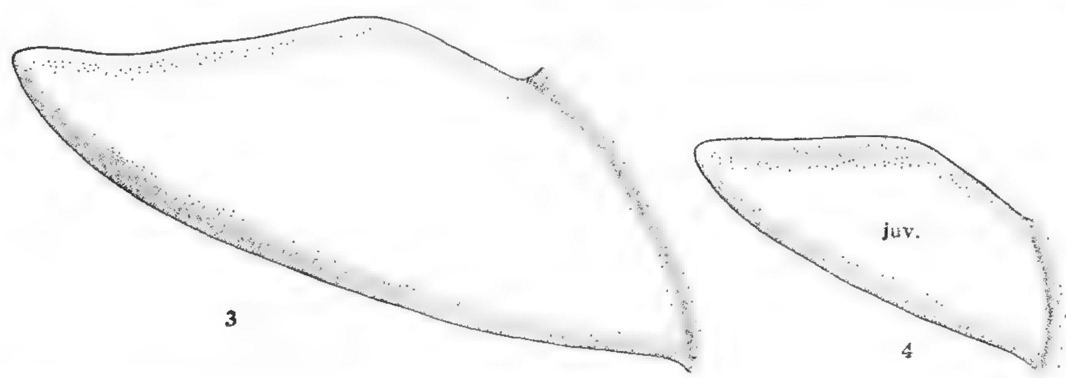

Fig. 3–4. Pectoral limbs of adult female and calf from Port Victoria (1/5 nat. size).

distance then suddenly rises steeply, with little forward inclination, to a rounded dorsal "point."

The falcate dorsal fin (text fig. 1) is about three and one half times as long as high and is placed just behind the middle of the length. The pectoral limb is two and three-fourths times as long as deep (text fig. 3).

In the female calf from Port Victoria the body is relatively plumper than in the adult, being less than four times as long as deep; the origin of the dorsal fin is slightly further behind the middle of the length. This fin is falcate (text fig. 2) and is three times as long as wide while the pectoral limb (text fig. 4) is a little shorter in proportion to its width than in the adult and is also shorter in relation to the total length of the animal. The snout as seen from the side exhibits quite considerable difference in shape, curving upwards and forwards from the distal end of the mandible much more obliquely than in the mother (see pl. xiv).

It is generally considered that the specimens of *Kogia* so far secured in both northern and southern hemispheres represent only one species; from the literature there is little or no evidence for the separation of two or more forms on external or skeletal characters.

There are few good illustrations of the exterior of *Kogia*. According to most published descriptions, but not always to the illustrations, the origin of the dorsal fin occurs at, or a little posterior to, the middle of the total length of the animal An exception may be the New South Wales example recorded by Krefft (1865, p. 708, fig. 1) in which the total length is given as 10 ft. 8 in., the distance before dorsal fin as 5 ft. 3 in.; Krefft's figure, however, shows the fin as arising well behind the middle of the length.

Allen (1941, pp. 28–29) notes that in a large male from Massachusetts the dorsal fin was low and narrow while in an adult female from Virginia it was nearly twice the size. In Allen's female the height of this fin was distinctly more than one-half of its basal length and at least one-fifteenth of the total length of the animal; the aforementioned author remarks that future observations may show whether or not this is a normal sexual difference. The female from Madras figured by Owen (1866, pl. x–xi) similarly has a high dorsal, and this applies also to the example from Ceylon illustrated by Pearson (1920, pl. i; sex not given).

Of southern examples the data previously published refer to unsexed material. Oliver (1922, p. 567, pl. ii, fig. 3) illustrates an example from Wanganui, New Zealand, with the dorsal fin very little smaller than in the aforementioned northern females; he notes that at least eleven specimens of *Kogia* "have been cast ashore in New Zealand during the past 40 years." The last-named author says of another New Zealand example, "Dorsal fin small, falcate." In the New South Wales specimen described by Wall (1851) it seems to have been much as in the Port Victoria female, while the poor illustration of Krefft (1865, fig. 1) shows this fin as low and rounded.

As noted above, in both the adult female and female calf from Port Victoria the height of the dorsal fin is, at most, one-third of the length of the fin; further, the height is equal to only about one-thirtieth of the total length of the animal.

Thus it would seem from available evidence that the fin is subject to considerable individual variation; on the other hand more adequate information regarding this and other features may show that geographic races or subspecies exist.

NOTES ON EXTERIOR OF FOETUS.

The Port Victoria foetus is a male. The most striking general features as compared with the adult are the shape of the relatively large head and the anterior position of the nostril (text fig. 5). From the vertex to the front of the snout the

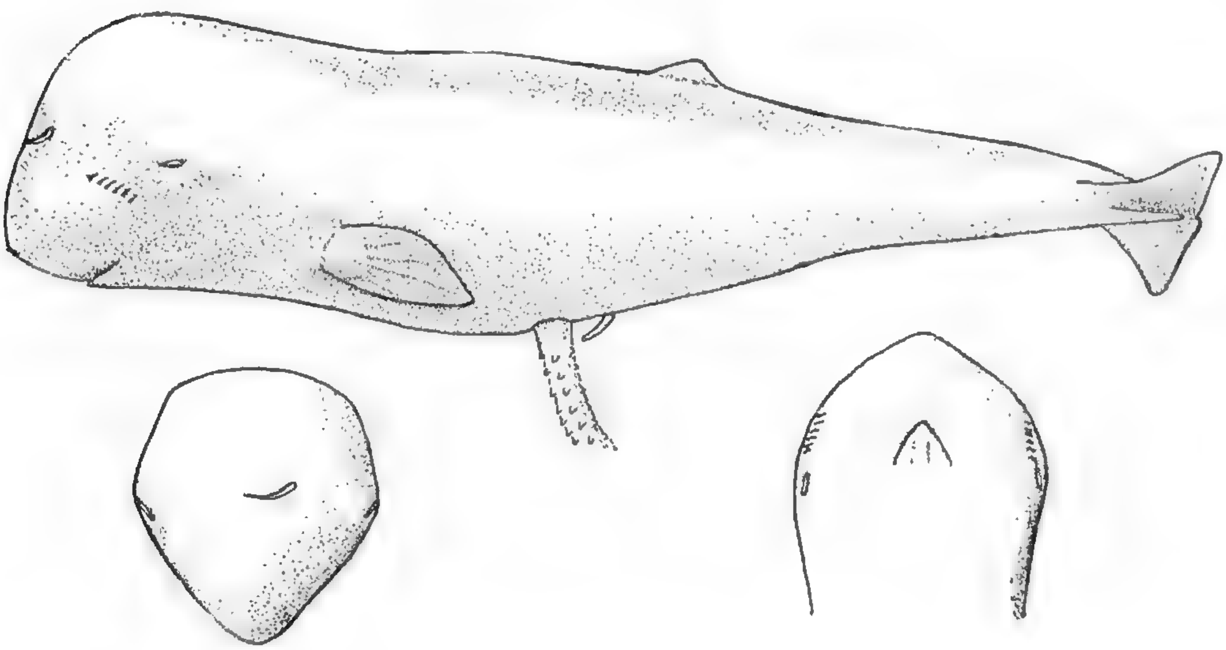

Fig. 5. Male foetus from Port Victoria; whole animal from the side, and anterior and ventral views of head (⅔ nat. size).

head slopes downwards very much more abruptly than in the more advanced foetus recorded by Allen (1941, fig. 1) and is more like the large foetus (1,097 mm.) described by Schulte and Smith (1918, p. 7, fig. 1). The crescentic nostril lies for the greater part to the left of the mid-line and is directed upwards to the left (text fig. 5); its lowest point is barely above the level of the upper edge of the eyes. The last-named are slightly asymmetrical as regards position, the left eye being 1 mm. closer to the front of the snout than the right. In advance of, and immediately below each eye is an oblique row of six minute, backwardly curved vibrissae, each of which projects from a pit; the second and third hairs of the

left side are placed closely together but the rest, including all of those on the right are evenly spaced. Schulte and Smith (1918, p. 11) state that, in the foetus examined by them, "Four hairs, arranged in an oblique line, were present in front of the eye," and state further that the intervals suggest a fifth in the middle of the series. Allen (1941, p. 28) found in his foetus, "four short, tapering bristles placed in an oblique row in front of each eye." The last-named author describes five well-marked grooves on the throat but in the specimen now recorded the skin in this area is perfectly smooth, possibly due to its earlier stage (text fig. 5, lower right).

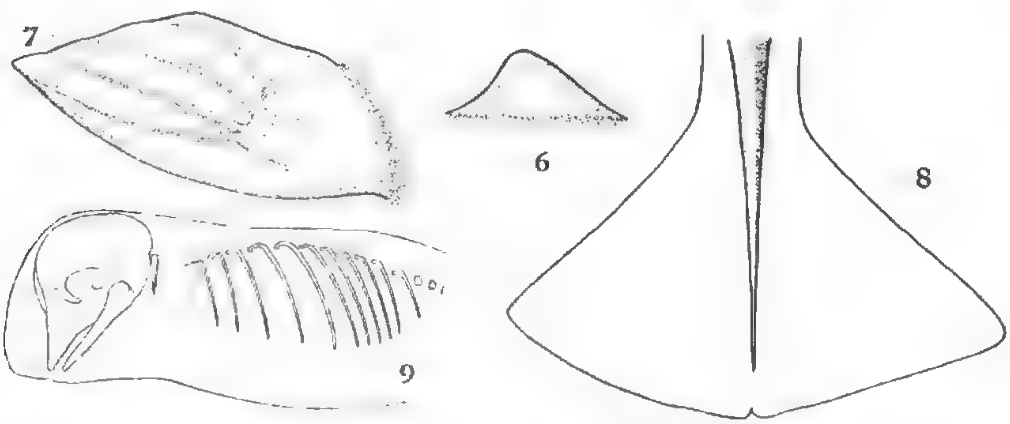

Fig. 6–9. Male foetus from Port Victoria; 6–8, dorsal, pectoral and caudal fins (× 1½); 9, tracing of X-ray of head and thorax to show position of skull, etc. (3/7 nat. size).

The body of this small foetus is a little more than four times as long as deep. The dorsal fin is not falcate but is triangular and low, being considerably less than three times as long as high (text fig. 6); it is placed distinctly posterior to the middle of the length. The pectoral limb is not quite two and one-half times longer than deep; the digits are visible through the thin exterior tissues but an X-ray photograph discloses no ossification of phalanges, etc. (text fig. 7).

The caudal fin (text fig. 8) has not yet developed backwardly flaring flukes, the posterior margin of the fin being convex; the lateral edges are almost straight and a small median posterior notch is present.

A photograph of the foetus secured immediately after removal from the uterus accompanied the writer's original brief record of the Port Victoria material (Hale, 1939, p. 7).

The measurements given herein for it are taken from the formalized specimen; its total length before preservation was slightly greater, viz. 203·2 mm. It should be added that the measurement from tip of snout to anus is 132 mm.

External measurements of *Kogia breviceps*, Port Victoria, South Australia.

	Adult ♀		Juvenile ♀		Foetus.	
	mm.	per cent.	mm.	per cent.	mm.	per cent.
Total length to notch of tail flukes	2,897	100	1,710	100	193	100
Greatest depth of body	660	22·8	470	27·5	47	24·4
Tip of snout to vertical level of anterior corner of eye	337	11·6	229	13·4	24	12·4
Tip of mandible to vertical level of anterior corner of eye	229	7·9	140	8·2	10	5·2
Tip of snout to vertical level of anterior edge of dorsal fin	1,499	51·7	915	53·5	103	53·4
Tip of mandible to axilla	610	21·1	380	22·2	40	20·7
Tip of mandible to anterior point of genital slit	1,919	66·2	—	—	78	40·4
Width of flukes	700	24·2	410	24·0	34	17·6
Height of dorsal fin	91	3·1	63	3·7	4·5	2·3
Length of base of dorsal fin	322	11·1	185	10·8	12·5	6·5
Length of pectoral fin along anterior edge	397	13·7	216	12·6	28	14·5
Greatest width of pectoral limb	144	5·0	84	4·9	11·5	6·0
Length of gape	150	5·2	77	4·5	8·5	4·4
Length of eye	31	1·1	22	1·3	4·0	2·1
Depth of eye	17	0·6	14	0·8	—	—

THE SKELETON.

Adult female, Port Victoria. The skull (pl. xv, fig. 1–5) is almost one-seventh of the total length of the whole animal (see Schulte, 1917, p. 366). Fusion of the sutures is much more advanced than in the Sleaford Bay example described below.

The rostrum from tip to anterior wall of left nostril is decidedly more than half of the total length of skull. The supraoccipital, as seen from the side, is concave and the condyle is prominent. The frontal is not distinctly marked off from the occipital complex. The lateral surface of the left maxilla is deep, two-thirds as deep again as the right. The maxillo-malar suture on the left side has a V-shaped downward projection at about first fourth of length of malar, where the suture sweeps abruptly upward; at the rear the suture curves downwards and thus the malar, measured along this suture, is longer than deep. The maxillo-malar suture of the right side is in the form of one very wide V, the caudal two-thirds being almost horizontal.

The mid-facial crest overhangs the fossa of the left maxilla strongly in its rostral half. The right premaxilla reaches the summit of the crest at the vertex where both it and the left maxilla are swollen and equally elevated, with the suture between almost obliterated. The prefrontal is truncate in front and forms a high thin crest between the nares; this ethmoidal part of the crest fades out just before the anterior end of the sagittal crest formed by left maxilla and right premaxilla.

The maxillae below the anterior parts of the transverse crest are thicker than in the younger Sleaford Bay example; the greatest width across the maxillae to

the maxillo-malar sutures is one and two-fifths times the distance between the vertex and the level of the antorbital processes. The antorbital fissures are correspondingly more oblique than in the Sleaford Bay skull; they are slit-like and almost closed excepting at the fundus.

The palatal surface is moderately convex; a relatively considerable portion (65 mm.) of the premaxilla appears between maxilla and vomer on right side and a smaller part (50 mm.) of the left premaxilla is visible. On each maxilla an alveolar groove extends back from tip for a distance of 12 cm. or so, neither of the furrows nearly reaching to level of antorbital tubercles; the right sulcus is a partly closed irregular fissure; the left is deeper and is crossed not far from tip of rostrum by an oblique bridge. No teeth were discovered.

The width between the postorbital process is greater than elsewhere.

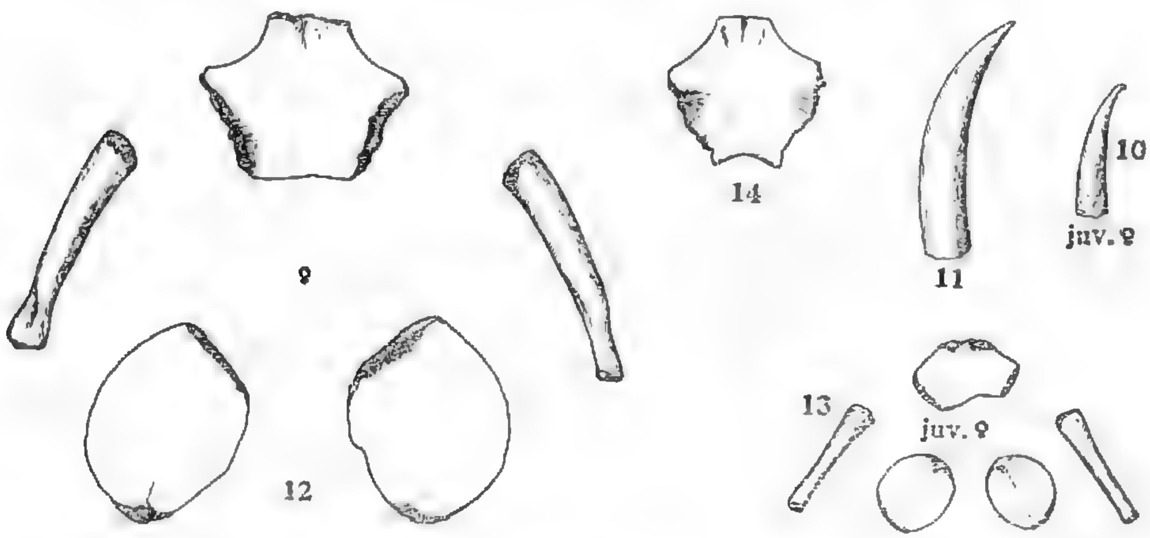

Fig. 10–11. Tooth from Port Victoria female calf and from Sleaford Bay example (approx. nat. size). Fig. 12–13. Tongue bones of adult female and calf from Port Victoria (¼ nat. size). Fig. 14. Basihyal of Sleaford Bay example (¼ nat. size).

The tip of the mandible on one side and some of the teeth are damaged. The teeth are smooth, subequal in size, are evenly curved and apparently numbered thirteen in each ramus.

In the tongue bones (text fig. 12) the basihyal is not subcircular as in the example illustrated by Benham (1902, p. 58, pl. iii) but is hexagonal; the antero-lateral and postero-lateral margins are concave; the anterior articular face is irregular and the posterior edge is barely notched near the mid-line; the bone, measured across the lateral angles, is one-fourth as wide again as long. The thyrohyals are suboval, longer than wide. The stylohyals are curved, slightly twisted bones; the articular face at the proximal end of each is broadly oval in

shape while the distal facet is narrowly oval and, because of the aforementioned twist, its long axis is almost at right angles to that of the proximal end.

The seven cervical vertebrae (pl. xviii, fig. 1–3) are ankylosed into a single unit, the height of which (106 mm.) is approximately three-fourths the greatest width (atlas, 42 mm.) There is a lateral foramen on each side between atlas and axis; posterior and a little below each of these is a larger single foramen, the opening extending apparently between the axis and seventh cervical. Seen from the side the combined neural arches present an unbroken dorsal outline, rising steeply and abruptly elevated at the rear to form a short rounded spine.

There are thirteen thoracic vertebrae. The first (pl. xviii, fig. 4) is free from the cervicals, but its anterior parts are quite closely applied to the posterior face of the neck vertebrae. The neural arch of the first thoracic is not complete, there being a dorsal gap of about 9 mm.; it is triangular rather than suboval, as it is in the other examples now examined (see pl. xviii, fig. 4) and the neural canal is only one-fourth as wide again as deep. In conformity with the asymmetry of the posterior ribs, as mentioned below, on the twelfth thoracic the tubercular facet on the right transverse process is 20 mm. in length and that of the left 30 mm.; the last thoracic has a small articular face on the thickened outer edge of the left transverse process but there is no such facet on the right side.

As in five of the other specimens which have been recorded (Allen 1941, p. 32) there are nine lumbar vertebrae.

The caudals number twenty-six, making a total of fifty five vertebrae, only one less than counted by Allen for the adult female from Virginia (Allen, *loc. cit.*). The metapophyses disappear after the fourth caudal, while the neural canal becomes an open groove on the summit of the thirteenth and disappears after the eighteenth caudal. There are fourteen pairs of chevrons, the members of all but one pair being united.

There are thirteen ribs on the left side but only twelve on the right; the anterior seven pairs have both tubercle and head. It will be noted from the table of measurements that the twelfth pair are markedly asymmetrical and that the right member of this pair, like the thirteenth rib of the left side, is abruptly shorter than the preceding rib. These last ribs are considerably shorter than the corresponding ones in the calf, but are much stouter.

The sternum (text fig. 15) consists of the usual three sections. The manubrium has broad, wing-like lateral expansions in the anterior half, where it is a little wider than its greatest length; in the posterior half the lateral margins are concave and converge towards the truncate hinder face which, like the anterior margin, is shallowly incised medianly. The second segment is less than two-thirds as long as the manubrium, is two-thirds as long again as wide, has concave lateral margins,

is slightly wider at anterior end than it is posteriorly and is medianly incised at front and back. The third segment is irregular posteriorly, with concave sides and has a medianly incised front margin; it is a little less than half as long as the manubrium, and is half as long again as its greatest width, which occurs near hinder end. The two component parts of each piece are completely ankylosed, but on the first and second segments there are interrupted median grooves.

In this specimen, and also in the calf, pelvic bones were specially searched for but none was located.

Female calf, Port Victoria. The skull (pl. xvi, fig. 1–5) is a little more than one-seventh of the total length of the animal (14·6% compared with 14·2% for the mother). The rostrum from tip to anterior wall of left nostril is much shorter than in the two adults described herein, being less than two-fifths as long as total length of skull. The supraoccipital in lateral view is slightly convex; actually along mid-line it is flat. The condyle projects prominently and the foramen is relatively larger than in the adult skulls. The frontal extends to the vertex as a thin strip between the occipital and the maxilla. The lateral surfaces of the maxillae are not deep. The malar is broadly triangular, distinctly longer than deep. On both sides the maxillo-malar suture dips at middle of its length in the form of a wide V. The prefrontal (ethmoid) is damaged but appears to have formed a crest continuous with the rest of the sagittal crest, which strongly overhangs the fossa of the left maxilla. The maxillae below the anterior parts of the transverse crest are only moderately thickened; the greatest width across the maxillae to the maxillo-malar sutures is one and one-fifth times the distance between the vertex and the level of the antorbital processes. The antorbital fissures are almost closed except at the fundus; the fissure of the right side is much more oblique than the other.

The palatal surface is markedly convex. On each side a portion of the premaxilla is visible at the tip, between vomer and maxilla. On each maxilla an open alveolar groove runs back from tip for a short distance (45 mm.) and is continued a further 15 mm. or so as a canal completely bridged by bone except for a tiny foramen on the right side. There is no trace of sockets or of teeth.

The width between the postorbital processes is equal to that between the zygomatic processes of the squamosal.

The tip of the left ramus of the mandible is missing; the right ramus has thirteen teeth subequal in size and differing from those of the adults now recorded in having the tips slightly hooked (text fig. 10).

The tongue bones (text fig. 13) like most of the rest of the skeleton are soft, very light and "chalky," and are easily abraded. The basihyal is very irregularly sexangular and is half as wide again as long. The thyrohyals are subcircular;

the stylohyals are much as described for the adult except that the articular facets on the widened proximal ends are relatively narrower.

The ventral element of the atlas and the rest of the cervical vertebrae are fused together into one solid mass (pl. xviii, fig. 5–7). The dorso-lateral part of the atlas is quite free (pl. xviii, fig. 8) but none of the remaining cervicals is marked off dorsally or dorso-laterally. The height of the cervicals (85 mm.) is slightly less than the greatest width (88 mm.), the latter being that of the free

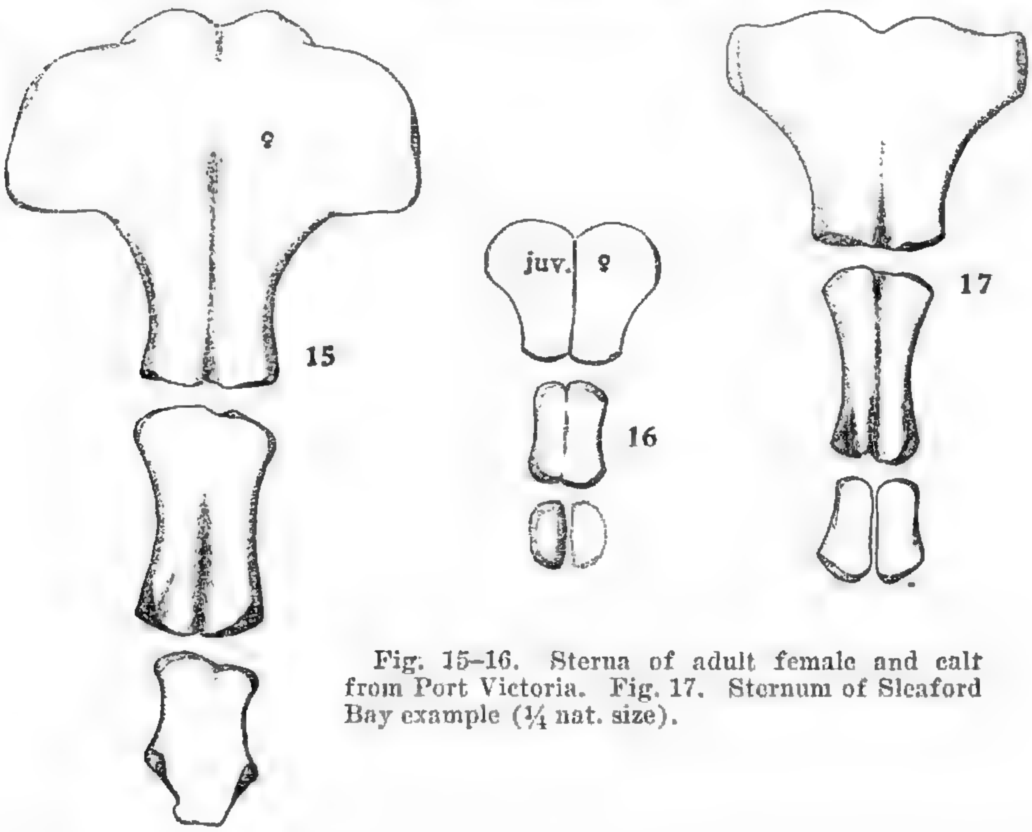

Fig. 15–16. Sterna of adult female and calf from Port Victoria. Fig. 17. Sternum of Sleaford Bay example (¼ nat. size).

portion of the atlas. On the right side of the ankylosed mass there is a large foramen, partially divided by an incomplete bony bar; on the right side two distinct foramina occur posterior to the axis, the hinder one being twice as deep as the other. The median dorsal spine at the rear of the cervical complex is low and rounded. In front of it the mid-line of the mass and of the atlas is sharply ridged, not rounded as in the adult.

The thoracic vertebrae are thirteen in number. The neural arch of the first is complete and the canal is about one-fourth as wide again as deep; on either side, ventrally, a small portion of the centrum is fused with the last cervical (pl. xviii, fig. 6–7). The epiphyses are trapped in the narrow space between cervicals and first thoracic but are quite free.

There are ten lumbar vertebrae and twenty-three caudals, making a total

of fifty-three vertebrae; the posterior caudals, however, are so small and fragile that it is possible that two or three have disappeared during maceration. In only one of the thirteen chevrons are the members of a pair not united. The metapophyses disappear after the third caudal, while the neural canal becomes an open groove on the twelfth caudal and is evanescent on the fourteenth. The ribs are thirteen on each side, the anterior eight pairs have a double articulation, and the ribs further differ from those of the mother in being less asymmetrical posteriorly (see measurements).

Length of ribs of *Kogia breviceps*, Port Victoria, South Australia; the measurements were taken in a straight line from head to free end.

	Adult ♀		Juvenile ♀	
	Right. mm.	Left. mm.	Right. mm.	Left. mm.
1	290	290	120	125
2	410	410	200	200
3	480	485	230	230
4	500	510	240	240
5	495	500	240	240
6	480	485	235	230
7	470	470	230	230
8	445	445	220	220
9	415	420	200	205
10	380	380	190	190
11	360	365	180	180
12	105	340	165	170
13	—	80	145	140

Relative to the total body length the sternum (text fig. 16) is considerably shorter than in the adult. The manubrium, though less expanded in anterior half, is proportionately shorter, and is nearly one-fourth as wide again as long; the two halves are incompletely fused in posterior two-thirds of length, and are separated by a fissure in anterior third. The second segment is one-third as long again as wide; its two parts are firmly fused, with a faint median groove. The third segment is composed of two separate pieces, one of which was damaged in stranding.

Adult, Sleaford Bay. The skull is illustrated on pl. xvii, fig. 1–5. The rostrum as measured from the tip to anterior wall of left nostril is slightly less than one-half of the total length of the skull. In lateral view the supraoccipital is markedly concave and the condyle projects quite considerably. The frontal extends as a thin strip between the occipital complex and the maxilla. The lateral surface of the last-named is not very deep (particularly that of the right side) and that of the malar is broadly triangular in shape (one-third as long again as deep). The maxillo-malar suture on both sides is sinuate and sub-horizontal except for a wide downwardly directed V in anterior half.

The sagittal crest between nostrils and vertex moderately overhangs the fossa

of the left maxilla in its rostral half; the right premaxilla reaches the summit of the crest at some little distance before the vertex, at which it is elevated, although only very slightly, above the left maxilla. The prefrontal is truncate anteriorly but does not extend as far forward in the canaliculate vomer as it does in the Port Victoria female; between the nares it forms a thin crest which is continuous with the rest of the mid-cranial crest but the latter rises abruptly at a right angle just posterior to the level of the nostrils. The area within the transverse maxillary crest is approximately as wide as long; the greatest width across the maxillae to the maxillo-malar sutures is very little greater than the distance between vertex and level of antorbital processes. The antorbital notches are narrow and oblique. The palatal surface is rather strongly convex and on each side a small portion of the premaxilla (length about 25 mm.) is wedged between maxilla and vomer. On the right side a deep and continuous alveolar groove extends back from the front of maxilla for a distance of 108 mm. On the left side the maxillary groove is longer (126 mm.) and reaches almost to level of antorbital tubercles; it is interrupted, in advance of middle of length by a short bony bridge. Apart from this last there are no indications of alveolar sockets and no teeth were present.

The width between the postorbital processes is barely greater than that between the zygomatic processes of the squamosal. As shown by the measurements and photograph (pl. xvii, fig. 5) the occipital foramen is rather narrow.

In the mandible (pl. xvii, fig. 6–7) the dental sulcus is lateral at the tip but slowly rises to the rear, its extreme posterior limit being dorsal in position. The groove in the left ramus is divided into fourteen sockets, each containing a tooth; in the right ramus there are thirteen pits. The anterior eight or nine of the sockets are separated by complete though exceedingly fragile bridges of bone, but the divisions between the posterior ones are much lower. The terminal portion of the sulcus takes the form of a short groove, much narrower and shallower than the preceding sockets. The teeth are smooth, subequal in length and are evenly curved (text fig. 11).

In the tongue bones the basihyal (text fig. 14) is as long as wide and, as in the Port Victoria adult, is markedly hexagonal. It differs, however, in having the posterior edge thin and concave from side to side while at the much narrower front the two articular facets are not confluent; the antero-lateral margins are concave and the postero-lateral attachment areas are very rugose. The thyrohyals are suboval.

As in the adult female noted above the cervicals (pl. xviii, fig. 9–11) are fused into one solid mass; there is little indication of the component bones dorso-laterally or dorsally. It differs in that the dorsal outline, as seen from the side, is concave intead of slightly convex anterior to the vertex, the dorsum is rather sharply ridged medianly and there is a lamellate expansion at the rear of the summit,

representing apparently the neural spines of the posterior cervicals. The height of the mass, about 115 mm., is subequal to the greatest width (atlas, 118 mm.). The foramina are as in the female referred to.

The neural arch of the first thoracic vertebra is complete; it is very different in shape from that of the adult female described, the neural canal being two-thirds as wide again as deep (pl. xviii, cf. fig. 4 and 12) and differs also in that the ephiphyses are quite free.

The first sternebra (text fig. 17) is broadly expanded at the front (where it is nearly one-third as wide again as long) and tapers to a broad stem; its anterior margin is sinuate, with a small median incision and there is only trace of a groove , on posterior half, indicating the fusion of the two component parts. The second segment of the sternum also consists of a single piece with a very feeble median gutter; it is four-fifths as long as the first and is widest anteriorly, where it is little more than half as broad as long, being thus considerably more elongate than in either of the other specimens recorded. In the third sternebra the two bones are completely separated.

Skull measurements of *Kogia breviceps* from South Australia.

	Sleaford Bay.		Port Victoria. Adult ♀		Port Victoria. Juvenile ♀	
	mm.	per cent.	mm.	per cent.	mm.	per cent.
Total length	351	100	410	100	250	100
Height to vertex	223	63·5	245	59·8	150	60·0
Width between postorbital processes	310	88·3	360	87·8	210	84·0
Hinder edge of occipital condyles to posterior wall of left naris	142	40·5	150	36·6	124	49·6
Height of supraoccipital from upper margin of foramen magnum to top of occipital crest	100	28·5	115	28·1	80	32·0
Width of supraoccipital at narrowest part between posterior margins of temporal fossae	200	57·0	214	52·2	155	62·0
Length of rostrum from tip to anterior wall of left naris	172	49·0	227	55·4	93	37·2
Tip of rostrum to anterior margin of palatines	136	38·8	170	41·5	76	30·4
Width of rostrum between antorbital processes	185	52·7	220	53·7	127	50·8
Greatest length of pterygoids	170	48·4	188	45·9	97	38·8
Length of left naris	43	12·3	47	11·5	33	13·2
Width of left naris	30	8·6	33	8·0	23	9·2
Height of foramen magnum	46	13·1	42	10·2	42	16·8
Width of foramen magnum	32	9·1	41	10·0	34·5	13·8
Height of occipital condyles	67	19·1	64	15·6	58	23·2
Width of occipital condyles	77	21·9	90	22·0	64	25·6
Length of mandible (mid-line between tip and level of back of condyles)	298	84·9	360	87·8	—	—
Length of left ramus of mandible (condyle to anterior end of symphysis)	320	91·2	380	92·7	—	—
Depth of left ramus at coronoid	86	24·5	100	24·4	—	—
Length of symphysis	70	19·9	80	19·5	48	19·2
Length of alveolar portion	133	37·9	140	34·2	83	33·2

Foetus, Port Victoria. Some details of the skeleton have been gleaned from an X-ray photograph. The skull is 41 mm. in greatest length; thus it is more than one-fifth of the total length of the animal, relatively much larger than in either the adult or calf. Its downward inclination (see text fig. 9) is more marked than in the adult as figured by Owen (1866, pl. xi, fig. 2). No trace of jugals can be seen.

One ossification is visible in the cervicals, immediately behind the skull and only eleven pairs of ribs are apparent. Posterior to this twenty-six ossification centres can be made out along the spinal column.

ENCOUNTER BAY RECORD?

Wood Jones (1925, p. 279) stated that in South Australia *Kogia* "is represented by a lower jaw obtained . . . . at Encounter Bay. In this lower jaw the teeth number thirteen on each side." The mandible referred to by Wood Jones has not been located with certainty in the mammalian collections of the South Australian Museum, which, at the time of the abovementioned note were being investigated by him. Apart from the examples described above, however, the only *Kogia* material in this Institution consists of a lower jaw without data and this has fourteen teeth in each ramus, the proximal one being considerably smaller than the preceding tooth.

FOOD.

The stomach of the adult female from Port Victoria contained only fragmentary remains of prawns, which appear to belong to the genera *Peneus* and *Hymenodora*. In the stomach of the calf which, as noted above, was apparently still suckling, there were remains of numerous small Cephalopods, beaks, funnels and corneas; the Museum Conchologist, Mr. B. C. Cotton, identifies these as belonging to a common South Australian squid, *Sepioteuthis australis*.

PARASITES.

No external parasites were present but the sides of the Port Victoria cow bore about sixty circular and semicircular healed scars, apparently the result of previous attachment of barnacles. The calf exhibited a dozen or so of similar, but in general smaller, scars.

Internal parasites of the adult comprised three species of Nematoda, described as new by T. Harvey Johnston and Patricia Mawson (*Anisakis kogiae, Porrocaecum kogiae* and *Crassicauda magna*) as well as encysted larvae of a Cestode, *Phyllobothrium delphini* (Bosc)—see Johnston and Mawson, 1939. The calf contained only *Anisakis kogiae*.

MATERIAL OF *KOGIA BREVICEPS* IN SOUTH AUSTRALIAN MUSEUM.

Lower jaw and teeth, ? Encounter Bay, South Australia. Reg. No. M. 5,606.

Adult female. Half cast and complete skeleton, Port Victoria, South Australia. H. E. A. Edwardes, April 25, 1937. Reg. No. M. 5,009.

Female calf. Half cast and complete skeleton, Port Victoria, South Australia. H. E. A. Edwardes, April 25, 1937. Reg. No. M. 5,010.

Male foetus. Whole animal in formalin, Port Victoria, South Australia. H. E. A. Edwardes, April 25, 1937. Reg. No. M. 5,011.

Skull, cervicals, first and second thoracics, sternum and first rib of unsexed example, Sleaford Bay, South Australia. Miss Nancy Follett, August–September, 1944. Reg. No. M. 5,197.

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EXPLANATION OF PLATES.

Plate xiv.

Scale drawings of *Kogia breviceps*, adult female and calf, stranded at Port Victoria, South Australia.

Plate xv.

Photographs of skull of *Kogia breviceps*, adult female, stranded at Port Victoria, South Australia.

Plate xvi.

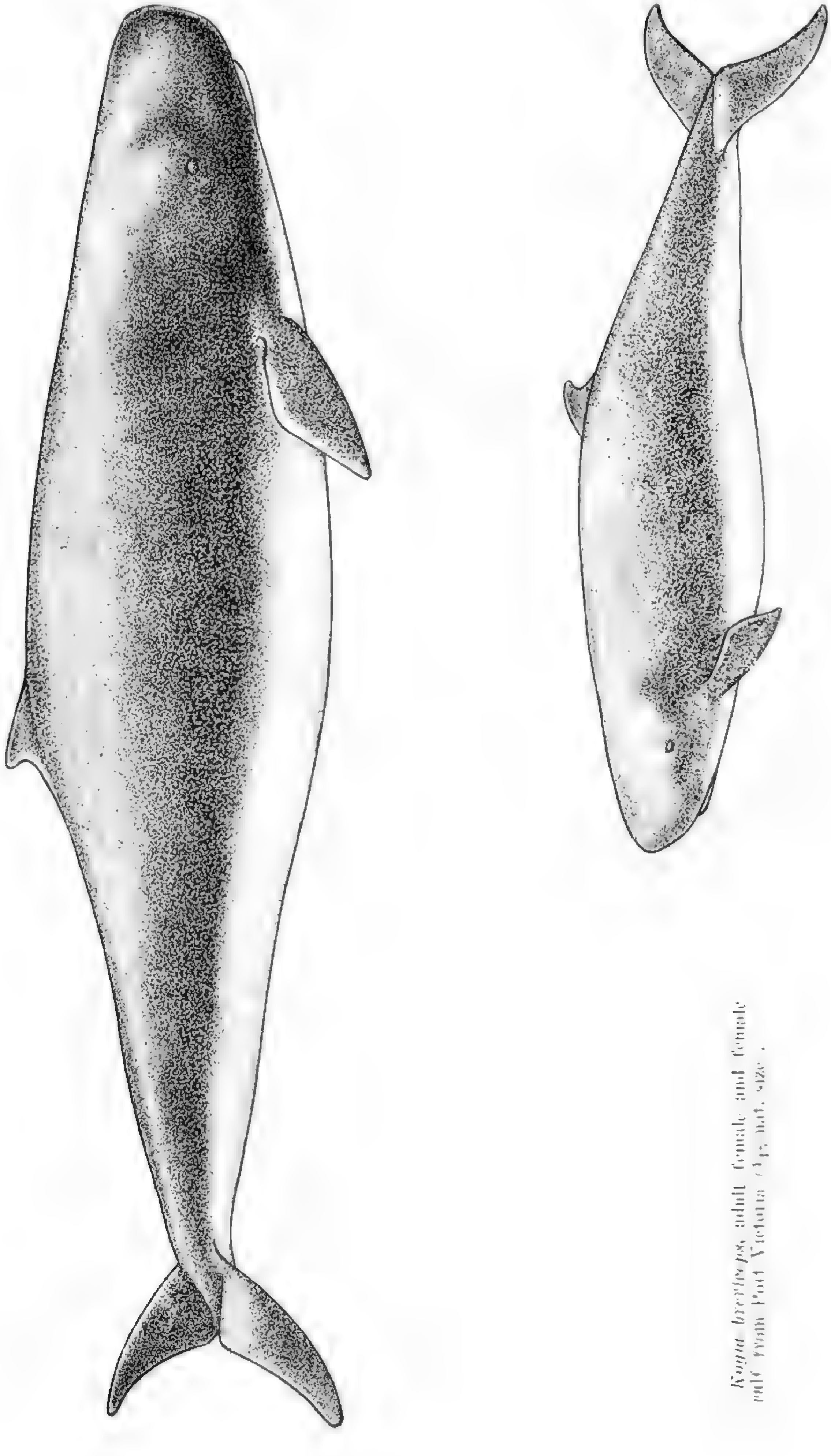
Photographs of skull of *Kogia breviceps*, female calf, stranded at Port Victoria, South Australia.

Plate xvii.

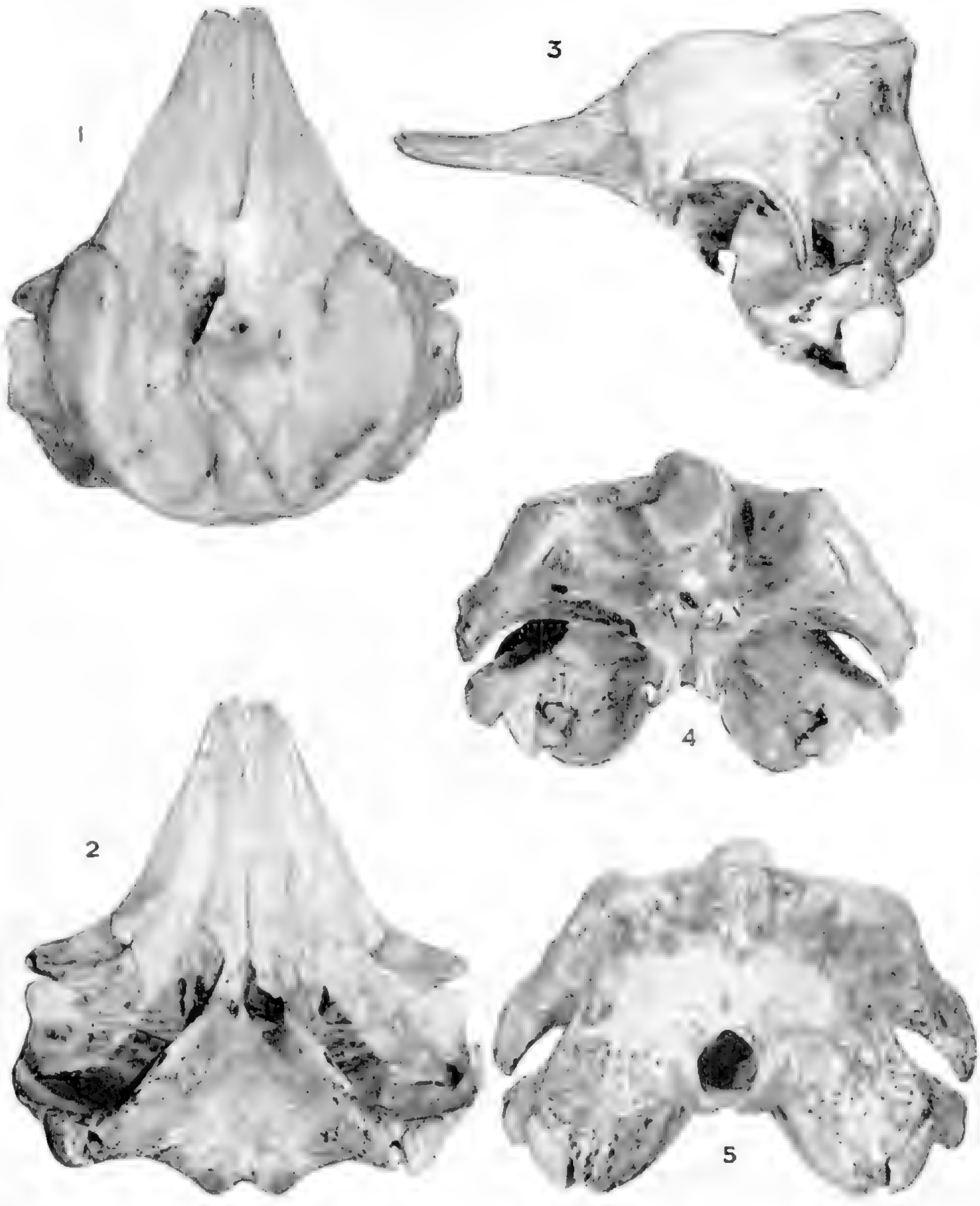
Photographs of skull and mandible of *Kogia breviceps* stranded at Sleaford Bay, South Australia.

Plate xviii.

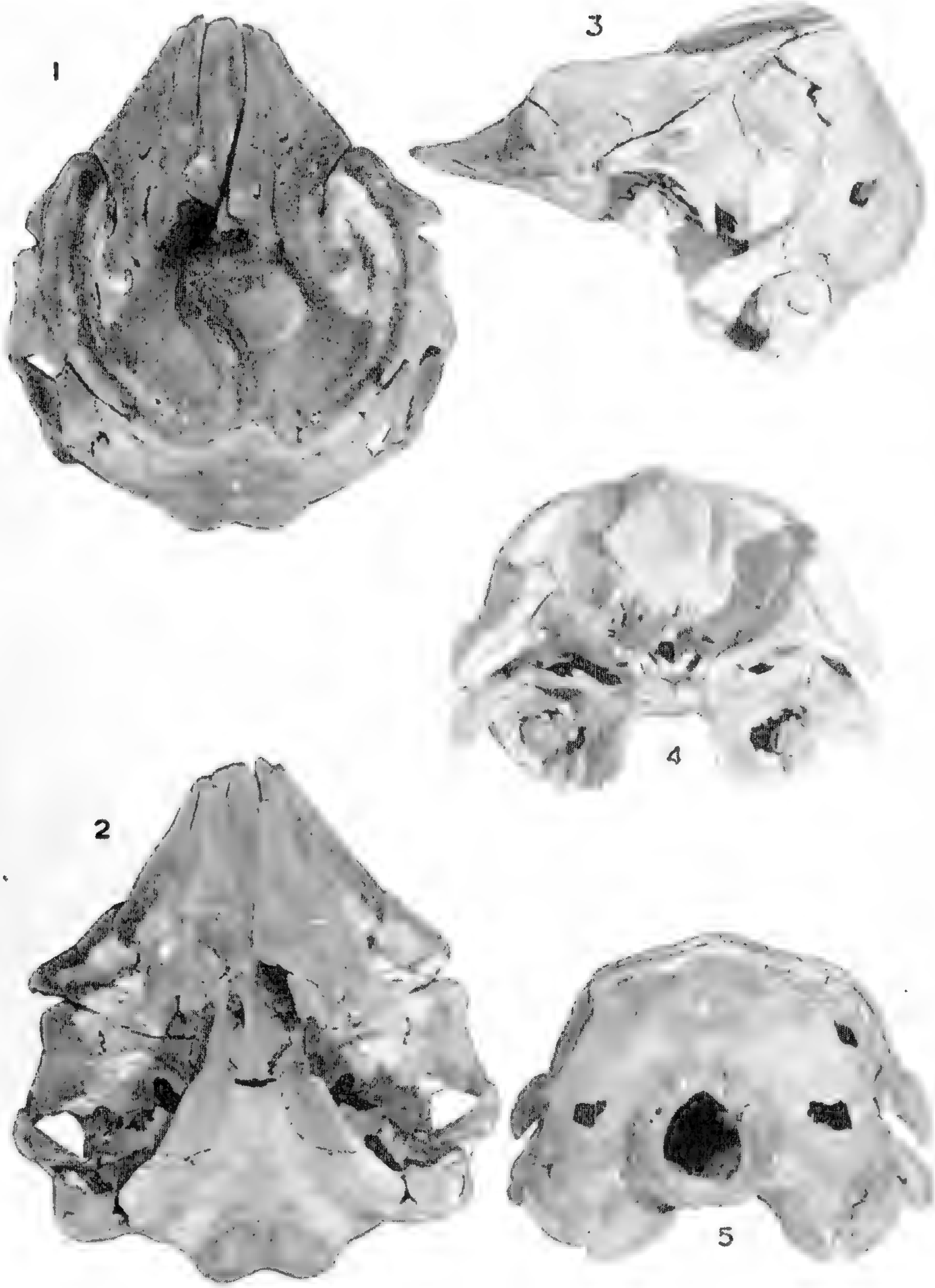
Photographs of cervical vertebrae, etc., of *Kogia breviceps*, from Port Victoria and Sleaford Bay, South Australia.



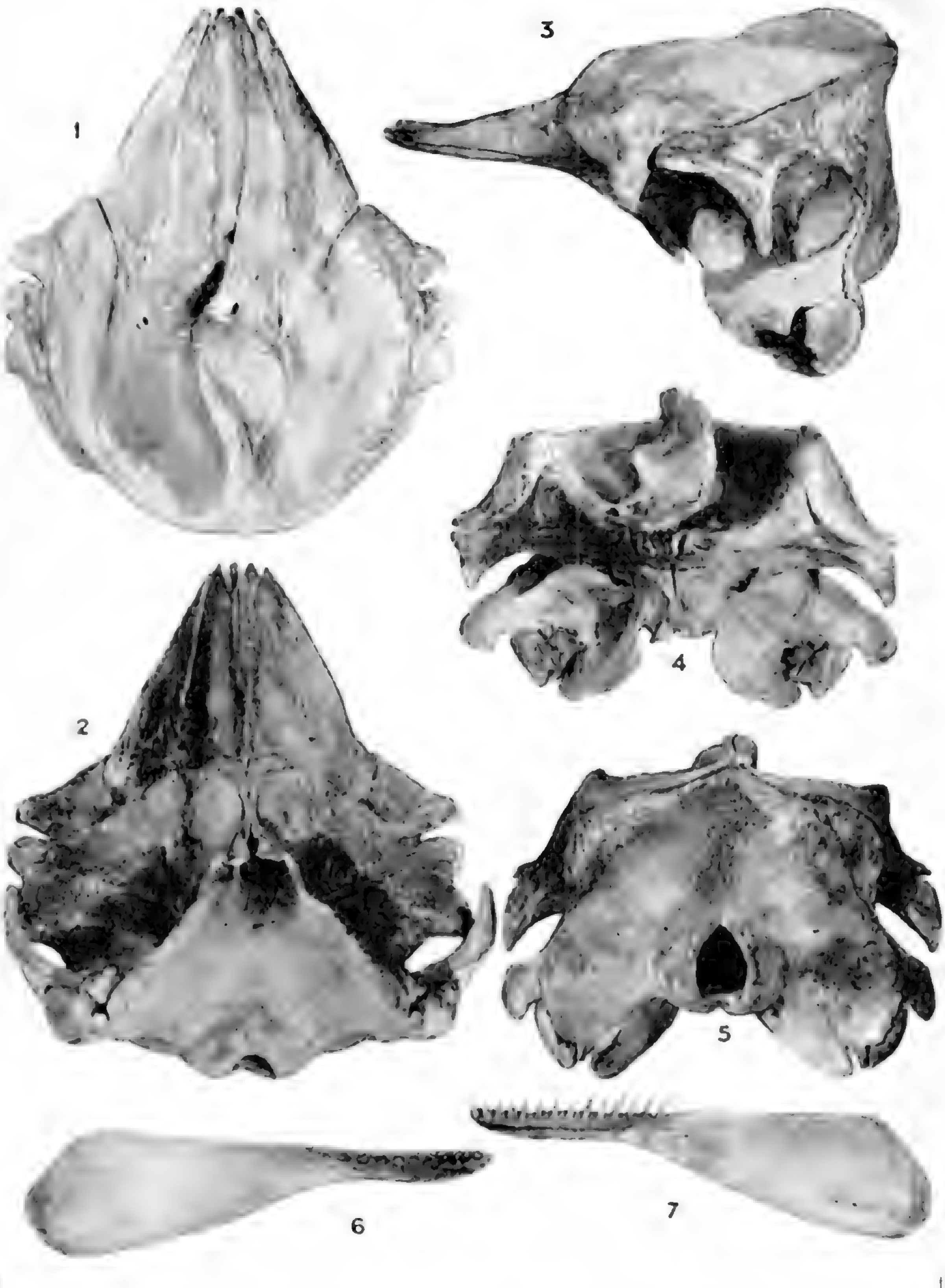
Kogia breviceps, adult female and female calf from Port Victoria (1/8 nat. size).



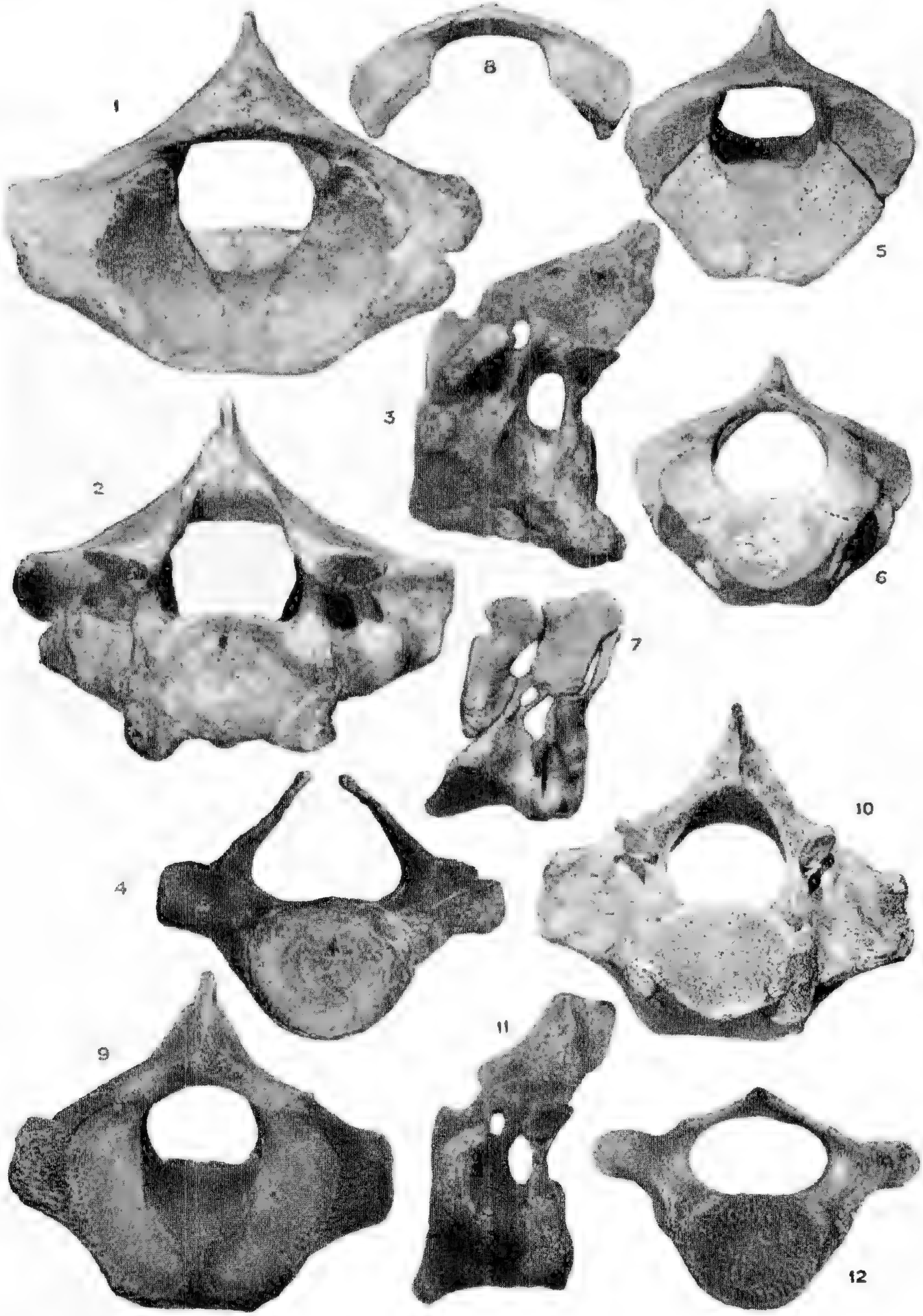
Kogia breviceps, adult female from Port Victoria; fig. 1–5, dorsal, ventral, lateral, anterior and posterior views of skull (approx. ⅙ nat. size).



Kogia breviceps, female calf from Port Victoria; fig. 1–5, dorsal, ventral, lateral, anterior and posterior views of skull (approx. ¼ nat. size).



Kogia breviceps, adult from Sleaford Bay; fig. 1–5, dorsal, ventral, lateral, anterior and posterior views of skull; fig. 6–7, rami of mandible—the teeth removed from right ramus (approx. 1/6 nat. size).



Kogia breviceps. Fig. 1-3. Anterior, posterior and lateral views of cervical vertebrae of Port Victoria adult female; fig. 4, first thoracic vertebra of same example. Fig. 5-7. Anterior, posterior and lateral views of cervicals, with attached first thoracic, of Port Victoria female calf; fig. 8, free dorsal part of axis of same example. Fig. 9-11. Anterior, posterior and lateral views of cervicals of Sleaford Bay example; fig. 12, first thoracic of same (all approx. ¾ nat. size).

SOME AVIAN AND FISH NEMATODES, CHIEFLY FROM TAILEM BEND, SOUTH AUSTRALIA

BY T. HARVEY JOHNSTON AND PATRICIA M. MAWSON, UNIVERSITY OF ADELAIDE

Summary

Unless otherwise indicated, the nematodes recorded in this paper were collected by the senior author from material obtained in the swamps at Tailem Bend, Murray River, South Australia, during the past nine years. We are indebted to the kindness of Messrs. G. G., F. and B. Jaensch and Mr. L. Ellis, of Tailem Bend, for their help in securing the hosts; and to the Commonwealth Research Grant to the University of Adelaide for financial assistance. Types of the new species have been deposited in the South Australian Museum.

SOME AVIAN AND FISH NEMATODES, CHIEFLY FROM TAILEM BEND, SOUTH AUSTRALIA

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Fig. 1–7.

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HOST-PARASITE LIST.

BIRDS.

CHENOPIS ATRATA Lath.: *Amidostomum cygni* Wehr.
MICROCARBO MELANOLEUCUS Vieill.: *Contracaecum* sp.
PHALACROCORAX CARBO Linn.: *Contracaecum spiculigerum* Rud.
PELECANUS CONSPICILLATUS Temm.: *Contracaecum* sp.
LARUS NOVAEHOLLANDIAE Stephens: *Capillaria laricola* (Wassilkowa).
CHLIDONIAS LEUCOPAREIA Temm.: *Contracaecum* sp.
NOTOPHOYX NOVAEHOLLANDIAE Lath.: *Contracaecum* sp.
PODICEPS RUFICOLLIS Stephens (var. NOVAEHOLLANDIAE): *Streptocara recta* (Linst.).
BIZIURA LOBATA Shaw: *Amidostomum biziurae* n. sp.
EUDYPTULA MINOR Forst.: *Contracaecum eudyptulae* J. and M. (Kangaroo Island).
GYMNORHINA HYPOLEUCA Gould: *Capillaria gymnorhinae* n. sp. (Adelaide).

FISH.

CRATEROCEPHALUS FLUVIATILIS McCulloch: *Eustrongylides gadopsis* J. and M.
PLECTROPLITES AMBIGUUS Rich: *Contracaecum* sp., larvae; *Ascarophis murrayensis* n. sp.; *Goezia fluviatilis* J. and M.; *Spinitectus plectroplites* J. and M. (syn. *S. percalates* J. and M.); *Capillaria plectroplites* J. and M.
PERCALATES COLONORUM Gunther: *Spinitectus plectroplites* J. and M.; *Goezia fluviatilis* J. and M., larvae.

McCULLOCHELLA MACQUARIENSIS C. and V.: *Goezia fluviatilis* J. and M., larvae; *Contracaecum* sp., larvae.

THERAPON (BIDYANA) BIDYANA Mitchell: *Contracaecum* sp. larvae.

PHILYPNODON GRANDICEPS Krefft: *Contracaecum* sp., larvae; *Eustrongylides gadopsis* J. and M., larvae (record omitted from our previous host list, J. and M., 1944, 60).

TANDANUS TANDANUS Mitchell: *Capillaria tandani* J. and M.; *Goezia fluviatilis* J. and M.; *Procamallanus* sp.; *Contracaecum* sp., larvae.

PSEUDAPHRITIS URVILLII C. and V.: *Ascarophis* sp., larvae; *Eustrongylides gadopsis* J. and M., larvae; *Procamallanus murrayensis,* J. and M.

NANNOPERCA AUSTRALIS Gunther: *Ascarophis* sp., larvae; *Contracaecum* sp., larvae.

GALAXIAS OLIDUS Gunth.*: *Contracaecum* sp., larvae; *Eustrongylides gadopsis* J. and M., Coorong.

NEMATALOSA EREBI Gunther: *Contracaecum* sp. larvae.

MUGILOGOBIUS GALWAYI McCull. and Waite: *Contracaecum* sp., larvae.

RETROPINNA SEMONI Weber: *Eustrongylides* sp. (probably *E. gadopsis*), larvae.

SALMO FARIO Linn.*: *Eustronglylides gadopsis* J. and M., larvae, from Cooma and Bombala, New South Wales, and from Canterbury Province, New Zealand.

*Material from host species indicated in this report by an asterisk was collected in localities other than the Tailem Bend region.

EUSTRONGYLIDES GADOPSIS Johnston and Mawson.

Larval worms of this species (of which we regard our *E. galaxias* as a synonym) were recovered from *Pseudaphritis urvillii, Craterocephalus fluviatilis, Galaxias olidus* and *Philypnodon grandiceps.* Very young larvae of *Eustrongylides* sp., probably *E. gadopsis,* were found in *Retropinna semoni.* We remarked previously (J. and M., 1944, 64) that this larval parasite was almost certainly the young stage of *E. phalacrocoracis,* occasionally found in the wall of the stomach of local cormorants.

We have identified the larva from material taken from the brown trout, *Salmo fario,* forwarded to us for identification from Cooma and Bombala, New South Wales, and from Canterbury Province, New Zealand.

CAPILLARIA GYMNORHINAE n. sp.

(Fig. 1.)

Two female Capillariids were taken from the magpie, *Gymnorhina hypoleuca,* from the Adelaide district. They measure 12–12·5 mm. in length; the breadth at the head is 15·6μ, at the base of the oesophagus 80–90μ, and at the widest part of

the body, 132μ. Bacillary bands are absent. The ratio of the lengths of the oesophageal and intestinal parts of the body is 1 : 3·7. The vulva lies just behind the oesophagus. The eggs (fig. 1) are thin-shelled, and measure 50μ by 25μ.

The worms do not agree with *C. pomatostomi* J. and M., 1945 (differing in the size of the eggs and in the ratio of the body parts); nor with *C. graucalina* J. and M., 1941 (differing in egg size); nor with *C. grallinae* J. and M., 1945 (which differs in the ratio of the body parts).

CAPILLARIA LARICOLA (Wassilkowa).

(Fig. 2.)

One female Capillariid worm was taken from a gull, *Larus novaehollandiae*. Its measurements fall within the limits given by Freitas and Lent (1935) in their redescription of *C. laricola* (Wassilk., 1930). The total length is 14·7 mm.; the breadth at the head 14μ, at the base of the oesophagus 76μ, and at the widest part 99μ (which is rather narrower than has been stated for the species). The eggs are 60μ by 30μ, and are smooth-shelled, without prominent polar plugs. Bacillary bands are present.

CAPILLARIA TANDANI Johnston and Mawson 1940.

(Fig. 4.)

This species was originally described from four females from the catfish, *Tandanus tandanus*. In the present collection a male worm is present. It is 3·3 mm. long. The posterior end of the oesophagus is indistinct, so that the ratio of the anterior to the posterior part of the body is uncertain. The breadth at the head is 10μ, and at the widest part of the worm, 54μ. The stout spicule is 225μ long. The spicule sheath, partly everted and obscuring the bursa, is markedly annulate. A figure of the wrinkled egg shell is given (fig. 3).

CAPILLARIA PLECTROPLITES J. and M. 1940.

(Fig. 3.)

From *Plectroplites ambiguus*. The species was originally described from females from this host species, and male worms from *Percalates colonorum* were also referred to *C. plectroplites*. In the present collection are males and females, the males agreeing with those described from *P. colonorum*. The spicule sheath is not spinous. Two bacillary bands are present, each consisting of two rows of sparsely scattered papillae.

AMIDOSTOMUM CYGNI Wehr 1933.

(Fig. 5.)

A single male worm was taken from the black swan, *Chenopis atrata.* The extreme posterior end is apparently damaged but the characters of the spicules and of the anterior end indicate that the parasite belongs to the genus *Amidostomum.* The total length is 6·8 mm., and that of the oseophagus, ·744 mm. The excretory pore is 171μ from the anterior end. The buccal capsule is stout-walled, its internal diameter 21μ, and its depth 12μ; it contains three teeth, one larger than the other two. The spicules, each of which is complex and terminates in two unequal prongs, are 153μ long. The canoe-shaped gubernaculum is 72μ long.

The bursa is absent, presumably having been torn off at its base.

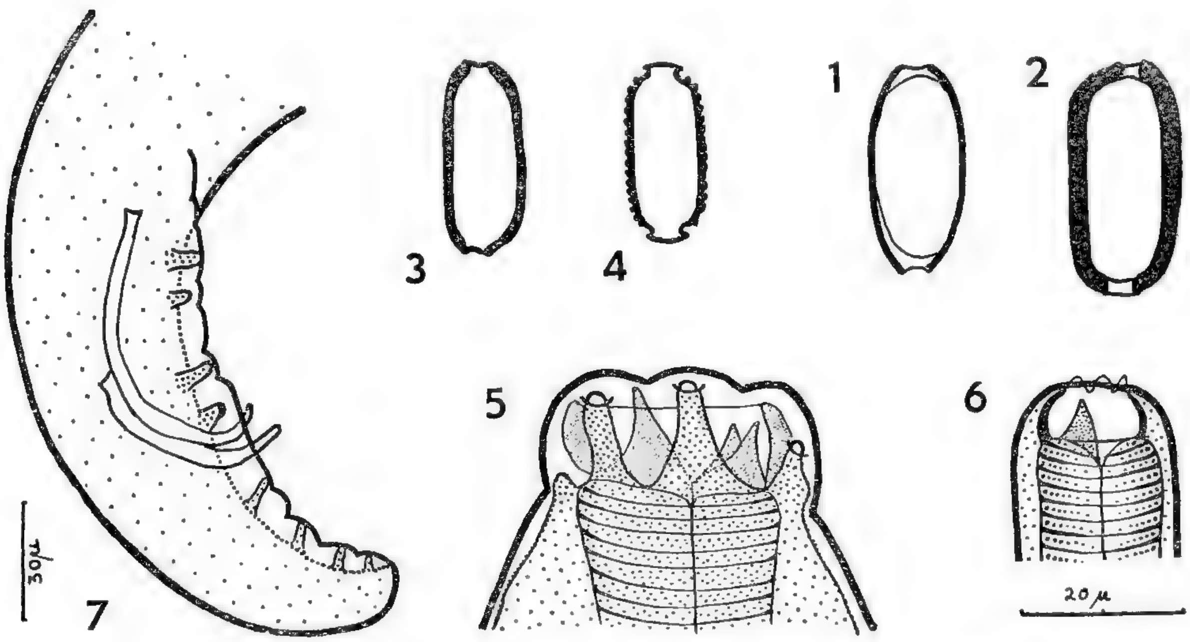

Fig. 1. *Capillaria gymnorhinae,* egg. Fig. 2. *Capillaria laricola,* egg. Fig. 3. *Capillaria plectroplites,* egg. Fig. 4. *Capillaria tandani,* egg. Fig. 5. *Amidostomum cygni,* head. Fig. 6. *Amidostomum biziurae,* head. Fig. 7–8. *Ascarophis murrayensis*: 7, anterior end; 8, posterior end of male. Fig. 1–4, drawn to the same scale; fig. 5 and 6 to same scale.

The specimen agrees with *A. anseris* (Zeder) R. and H. 1909, *A. spatulum* Baylis 1932, and *A. cygni* Wehr in having three teeth. Its spicules and gubernaculum are much shorter than those of the first two of these species. The worm differs from *A. anseris* also in the size of the teeth relative to that of the buccal capsule, and from *A. spatulum* in the absence of any "epaulette" structures. It is a rather shorter worm than *A. cygni,* but the proportions of the various parts are similar. In the absence of a bursa it is impossible to verify the identification completely, but we suggest that our specimen belongs to *A. cygni.*

AMIDISTOMUM BIZIURAE n. sp.

(Fig. 6.)

A single female worm referable to the genus *Amidostomum* was taken from the musk duck, *Biziura lobata*. Its measurements and characters were not found to correspond with those of any known species of the genus, and a brief description is now given.

The total length is 7·9 mm., that of the oesophagus is indeterminable. The buccal capsule is thin-walled, about 11μ wide, 7μ deep, and contains one large tooth. Its upper edge appears to be prolonged into six small digitiform projections. The vulva is 1·7 mm. from the posterior end. The eggs are 65–75μ by 37μ.

Though the material on which the description is based is so scanty, the status of a new species is suggested for it, as being convenient for future reference.

CONTRACAECUM SPICULIGERUM (Rud.).

This common nematode, already reported as occurring in the stomach of various Australian cormorants, is now recorded from *Phalacrocorax carbo* from Tailem Bend, where the bird is not often seen. The parasite was mentioned previously from this host species in New South Wales by Johnston (1912, 75) as *Ascaris* sp.

CONTRACAECUM EUDYPTULAE J. and M.

This parasite has been taken from a penguin, *Eudyptula minor*, from Kangaroo Island.

CONTRACAECUM spp.

Nematodes belonging to the same genus have been obtained from a number of birds and fish. In some cases the material was recognisable and has already been recorded, but in many cases the worms were too young or too poorly preserved for satisfactory identification and are here listed as *Contracaecum* sp. The bird hosts were *Pelecanus conspicillatus*, *Microcarbo melanoleucus*, *Chlidonias leucoparcia*, *Notophoyx novaehollandiae* and *Egretta alba*.

Very young worms were found sparingly in the mesentery and omentum adjacent to the stomach and upper intestine of the following fish: *Plectroplites ambiguus*, *Therapon bidyana*, *Philypnodon grandiceps*, *Tandanus tandanus*, *Galaxias olidus*, *McCullochella macquariensis*, *Nannoperca australis*, *Nematalosa erebi* and *Mugilogobius galwayi*. These small transparent worms are probably the larva of *C. spiculigerum* from cormorants and *C. bancrofti* from pelicans.

GOEZIA FLUVIATILIS J. and M. 1940.

This short, thick, maggot-like nematode was described originally (J. and M. 1940, 342) from *Plectroplites*, *McCullochella* and *Percalates;* and larval stages were recorded from *Nannoperca* and *Tandanus* from Tailem Bend and from *Mogurnda adspersa* from the Burnett River, Queensland. We have identified the species from *Plectroplites ambiguus* from the Thompson River at Longreach, Western Queensland; and in a dead specimen of the same species of fish from Murray Bridge we found that the liver was extensively burrowed by adults of the parasite.

Larval stages have now been collected from the omentum of *Percalates colonorum* and *McCullochella macquariensis*, from both of which fish adults had previously been collected. Very small larvae are to be found in *Tandanus tandanus* occupying spherical, or somewhat flattened and lenticular, pedunculated cysts, measuring about ·35 mm. in diameter and each containing a larva about ·8 mm. in length.

SPINITECTUS PLECTROPLITES J. and M. 1940.

Syn. *S. percalates* J. and M. 1940.

From *Plectroplites ambiguus*. The species was described originally from females only; but males have now been collected from the type host, and have been found to agree in length and in the features of the posterior end, as well as other characters, with those of *S. percalates*. The latter species was differentiated from *S. plectroplites* by the length of the vestibule in relation to the position of the first ring of spines and to the width of the head. Among the large numbers of specimens now available for study, all from *Plectroplites ambiguus*, are female and male worms with the type of head described as *S. plectroplites;* others with that described as belonging to *S. percalates*; as well as others with more or less intermediate characters. It is therefore suggested that the differences may be due to the state of contraction of the worm, or that the character may be variable within the species. In all other respects the worms are similar. *S. percalates* thus falls as a synonym of *S. plectroplites*.

ASCAROPHIS MURRAYENSIS n. sp.

(Fig. 7–8.)

From the callop, *Plectroplites ambiguus*.

Female, 3·1–5·4 mm. long; vestibule 90–93μ long; anterior narrower part of oesophagus ·13–·19 mm. long, posterior part ·4–·8. Nerve ring at ·1 mm. and excretory pore at ·13 mm. from head end respectively. Vulva at about middle of body. Eggs, $28\mu \times 19\mu$.

Male, 2·8–3 mm. in length; vestibule ·1 mm. long; anterior part of oesophagus ·14 mm., posterior part ·6 mm. long; excretory pore ·17 mm. behind head. Spicules, 50μ and 100μ long. Caudal alae somewhat narrow for the genus, supporting four pairs of preoral and five pairs of postanal papillae. The ventral surface around the cloaca is beset with small cuticular tubercles.

Larval worms, often encysted, and of a type referred to in a previous paper (J. and M. 1941, 260) under *Acuaria* (s.l.) sp., larvae, as having been recovered from two birds and from *Retropinna semoni*, are now recorded from various hosts, namely *Nannoperca australis*, *Pseudaphritis urvillii*, and *Plectroplites ambiguus*. These worms are also very like certain larvae from fish from subantarctic waters recorded in B.A.N.Z.A.R.E. Reports (J. and M. 1945). Without infection experiments, it is probably impossible to tell which are the larvae of *Ascarophis* sp. or *Spinitectus* spp. from fish, and which of them belong to Acuariids living as adults in birds. Most of the known Acuariid life histories however involve an arthropod intermediate host, so it is probable that larvae found in fish will grow to the adult stage in the same host.

STREPTOCARA RECTA (Linst).

Streptocara recta (Linst) is again recorded from *Podiceps ruficollis novaehollandiae*. The measurements of the single female in this collection are as follows: body length 5·2 mm.; length of vestibule 27μ; length of anterior part of oesophagus ·25 mm., of posterior part 1·2 mm.; vulva 2 mm. from posterior end of body; eggs 35μ by 18μ.

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AUSTRALIAN ACANTHOCEPHALA, NO. 6

BY T. HARVEY JOHNSTON AND S. J. EDMONDS, UNIVERSITY OF ADELAIDE

Summary

The earlier papers in this series have been published in the Transactions of the Royal Society of South Australia (1929-1947). For assistance in regard to material we are indebted to the late Dr. T. L. Bancroft, of Eidsvold, Queensland; and to Professor J. B. Cleland, of the University of Adelaide.
The three species dealt with have been taken from birds. One, from Alectura lathami, is described as new; one, from Charadrius cucullatus, is attributed to a Japanese species; and the third, from a gull, Larus novaehollandiae, is assigned to a species previously known from South America.
Type material has been deposited in the South Australian Museum, Adelaide.

AUSTRALIAN ACANTHOCEPHALA, No. 6

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Fig. 1–30.

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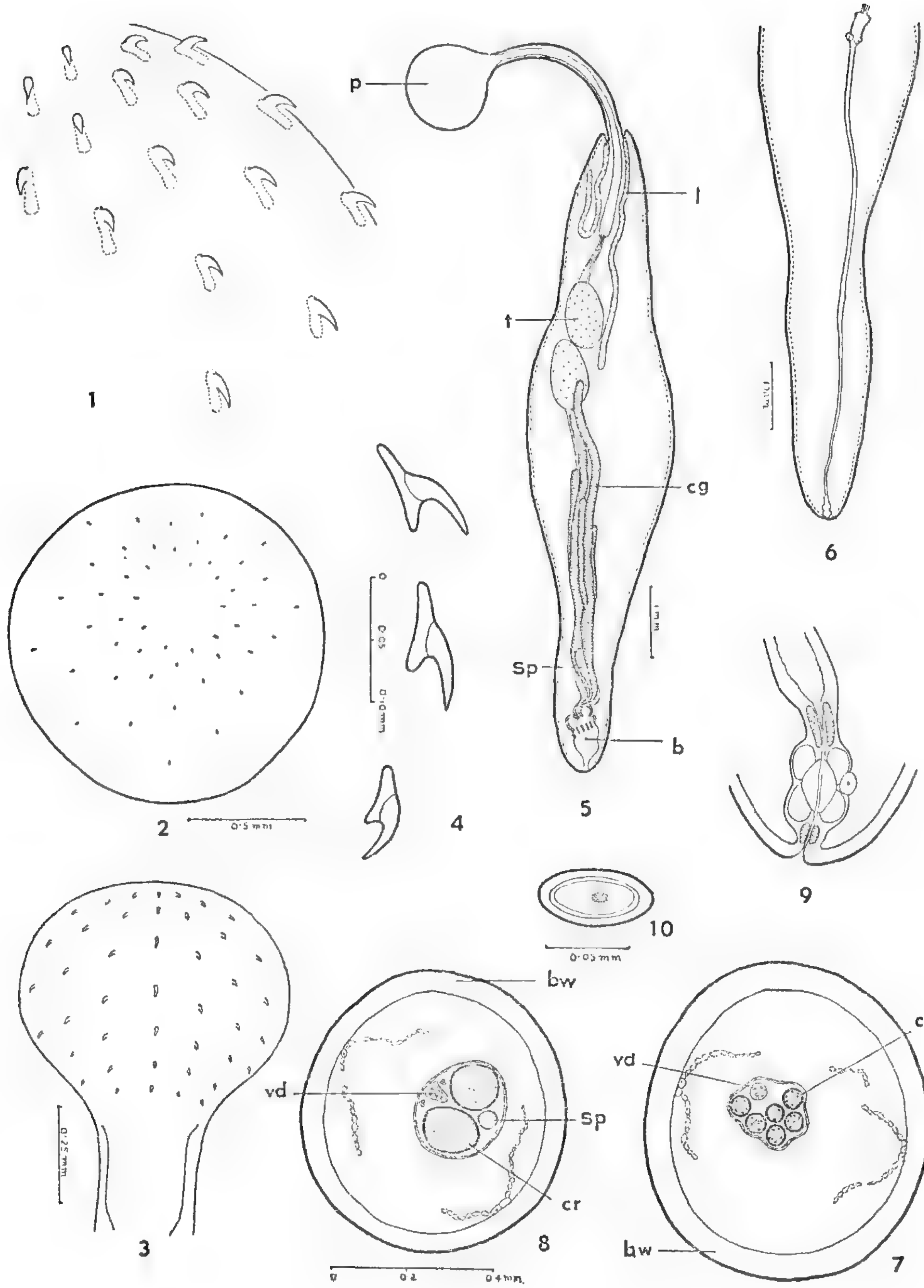
Filicollis sphaerocephalus (Bremser 1819) Travassos 1926.

Fig. 1–10.

Specimens of this echinorhynch were obtained from the intestine of the sea-gull, *Larus novaehollandiae* at Henley Beach, South Australia. The collection consists of a few mature and a large number of nearly mature worms. All the measurements given below, except where otherwise stated, were made on specimens preserved in formalin and cleared in methyl salicylate.

The worms are long and cylindrical with a constriction towards the anterior end. The length of the males ranges from 10–21 mm. (average 17 mm.), and that of the females from 9–22 mm. (average 18·5 mm.). The maximum width of the male is from 1·1 to 2·2 mm. (average 1·7 mm.), and that of the female 0·9 to 2·3 mm. (average 1·9 mm.). The proboscis is spherical to oblate in shape and when collected was firmly embedded in the intestinal wall of the host. Its diameter in the widest part ranges from 0·7 to 1·9 mm. The proboscis is armed with 19–21 longitudinal rows, each of 7–8 hooks, all of which are firmly attached by rooting processes. The arrangement and size of the hooks are shown in fig. 1–4. The proboscis is attached to the body by a long slender, retractile stalk or neck which measures up to 3·0 mm. long. The receptaculum is double-walled, is from 3·2 to 6·7 mm. long, and in the case of the male is connected with the testes. In most specimens minute spines are found on the anterior portion of the body. The two lemnisci measure from 2·0 to 4·8 mm. in length.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Male System. Two ovoid testes, 0·8 to 1·8 mm. in length and 0·5 to 0·9 mm. in width, are situated in the anterior half of the worm. Six long tubular cement glands which are pressed closely together, arise near the posterior testis in most cases. The two cement ducts are swollen basally to form two cement reservoirs. The vas deferens is distended at its posterior part to form a seminal vesicle. There is a well developed penis. Saefftigen's pouch is club-shaped and the bursa bears a number of rays.

Female System. The structure and arrangement of the female reproductive systems are shown in fig. 6, 9. The uterus proper is long, being usually about half the body length. Ripe eggs, measured in 70 p.c. alcohol, are 62–66μ by 30–37μ, and are without polar prolongations.

Systematic Position. Our specimens agree closely in most details with the account of *F. sphaerocephalus* (Bremser) published by Travassos (1926, 91) but there is a difference regarding the number and arrangement of the proboscis hooks. Bremser reported that there were 26–28 longitudinal rows, each with 10–14 hooks. Marval (1905, 322) mentioned 26–28 rows, each with 12–14 hooks. Travassos (1926) stated that there were 23 rows, each with 10 hooks. Meyer (1932, 76) published a summarized account of the species. Our specimens possess 19–21 longitudinal rows, each with 7–8 hooks but in spite of this difference, we have decided to assign them to *F. sphaerocephalus* which is known from *Larus dominicanus* and some other birds from South America. A variation in the number and arrangement of the proboscis hooks has been indicated by Perry (1942) in her account of *F. altmani* which has 25–30 (28) rows each with 9–12 (11) hooks.

EMPODIUS ALECTURAE n. sp.

Fig. 11–24.

A number of parasites of this species were collected by the late Dr. T. L. Bancroft from the intestine of *Alectura lathami* from Eidsvold, Burnett River, Queensland. All the specimens are long and flattened or cylindrical, and show well-marked pseudo-segmentation. The smallest specimen is 11 mm. long, 0·58 mm. wide, and white in colour. Most of the adult forms are pale yellow

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Fig. 1–10, *Filicollis sphaerocephalus.* 1. portion of proboscis; 2. arrangement of proboscis hooks; 3. proboscis of young male; 4. three posterior proboscis hooks from a large male; 5. male specimen; 6. posterior portion of female; 7. T.S. male showing 6 cement glands; 8. T.S. male in region of cement reservoir; 9. genital complex of female; 10. mature egg.

References to lettering: b. bursa; br. brain; bw. body wall; cg. cement gland; cr. cement reservoir; l. lemnisci; la. lacunar system; lm. longitudinal muscle; lp. lateral uterine pouch; m. muscle fibres; p. proboscis; ps. proboscis sheath; rm. retractor muscle; so. swimming ovaries; Sp. Saefftigen's pouch; sph. sphincter; t. testis; u. uterus; ub. uterine bell; vd. vas deferens; vs. vesicula seminalis.

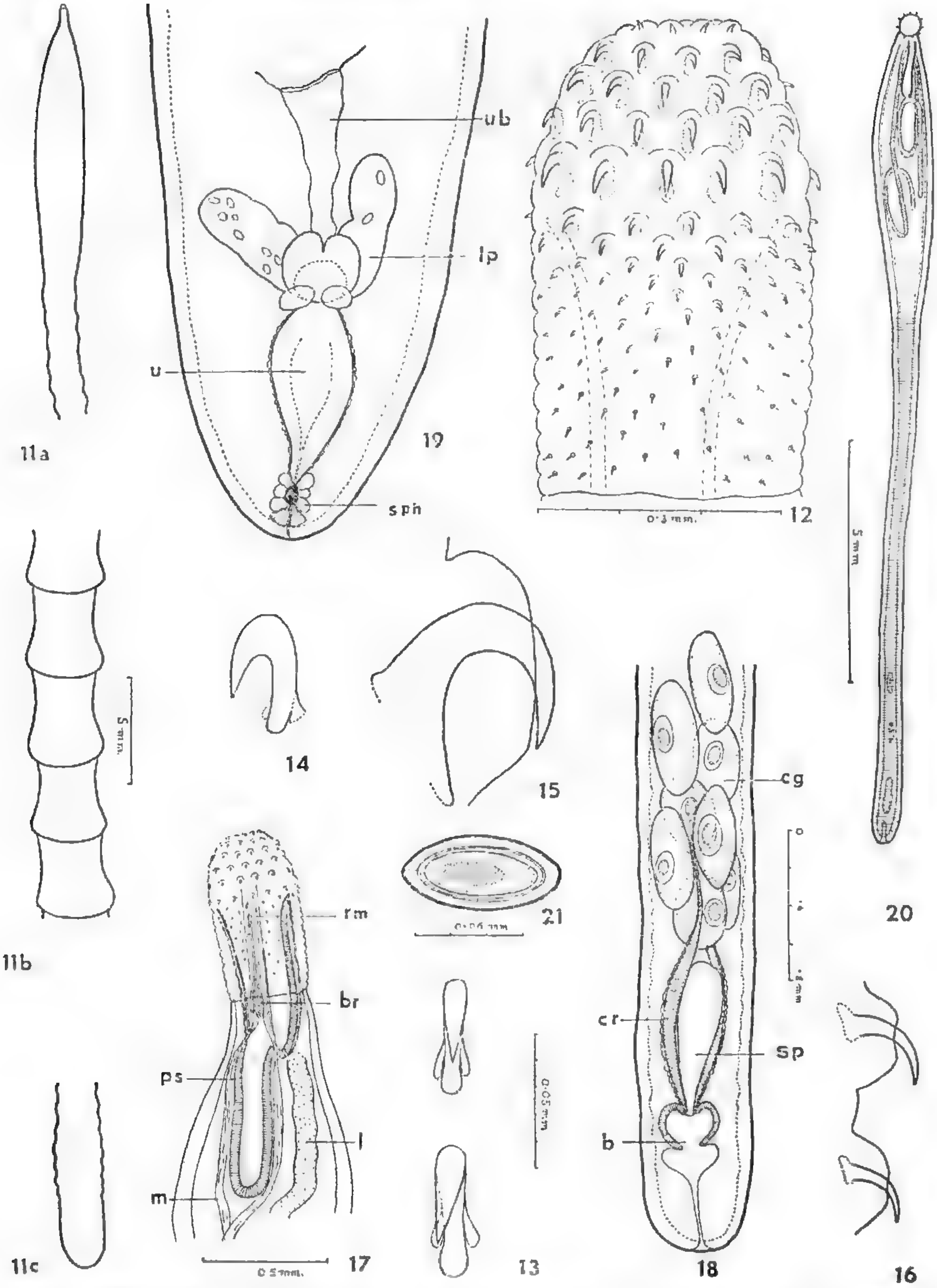

Fig. 11–21, *Empodius alecturae*. 11. (a) anterior region, (b) mid-region, (c) posterior region of female, all drawn to same scale; 12. proboscis; 13. anterior hooks from adult (rows 1 and 2); 14. anterior hooks from adult (row 3); 15. anterior hooks from adult (row 5); 16. hooks from posterior part of proboscis; 17. anterior part of male; 18. posterior region of male; 19. posterior region of female; 20. young male; 21 egg. (Fig. 13–16 to same scale.)

or straw coloured. The largest male is 170 mm. long and 1·0 mm. wide in the broadest part; it consists of about 200 "segments," while most of the females are about 230 mm. long and 1·4 mm. wide near the middle of the worm where the breadth is greatest. The collection also contains two very large females, each of about 280 segments, one measuring 65 cm. long and 3·9 mm. wide and the other 58 cm. long and 3·6 mm. wide. The specimens are probably the longest of all known echinorhynchs.

The proboscis is cylindrical and small when compared with the size of the worm. Its maximum dimensions are: male, length 0·52 mm., breadth 0·31 mm.; and female, length 0·73 mm., breadth 0·42 mm. It is armed with numerous hooks which fall into two groups. The anterior third of the proboscis is beset with 12 spiral rows of 5 hooks each and the posterior two-thirds with 12 spiral rows of 14–16 smaller hooks which are spiniform and less regularly placed near the neck region. Most of the hooks bear rooting processes, the shape of which we have not been able to determine satisfactorily. In the case of the anterior hooks it seems to be a three-pronged process (fig. 13 and 14). All the hooks arise from a slight swelling of the epidermis (fig. 15 and 16). The body of both sexes is smooth. The region of the animal immediately behind the proboscis is slightly swollen and contains the receptaculum and lemnisci. The pseudo-segmentation in this region in both sexes and in the posterior portion of the male is not very well marked externally. The proboscis receptaculum consists of two parts, an anterior portion which arises at the junction of the two groups of proboscis hooks and which is very thin ventrally (fig. 17), and a posterior sac-like portion with a single thick continuous wall (fig. 24). Muscle fibres pass from within the proboscis to enter the body cavity of the parasite at the junction of these two parts of the receptaculum. A similar type of proboscis sheath has been described by Meyer (1932, 181) in the case of *Empodius otidis* (Miescher). An oval brain is situated ventrally in the anterior portion of the proboscis. The lemnisci are much larger than the receptaculum. The lacunar system is well developed and consists of one long channel from which arise transversely, smaller circular collecting vessels.

Male System. Two elongate elliptical testes of approximately equal size are situated well towards the posterior part of the worm and their maximum dimensions are: length 2·5 mm., and breadth 0·65 mm. Eight elliptical cement glands, although closely pressed together, appear to be arranged in four pairs. There are two narrow cement ducts and a pyriform Saefftigen's pouch. The male opening is terminal.

Female System. The female complex is small in comparison with the size of the animal. Its structure is shown in fig. 19. The typical uterine bell of an echinorhynch seems to be either collapsed or lacking in most of our female specimens. A structure of very thin tissue which possibly acts as a uterine bell,

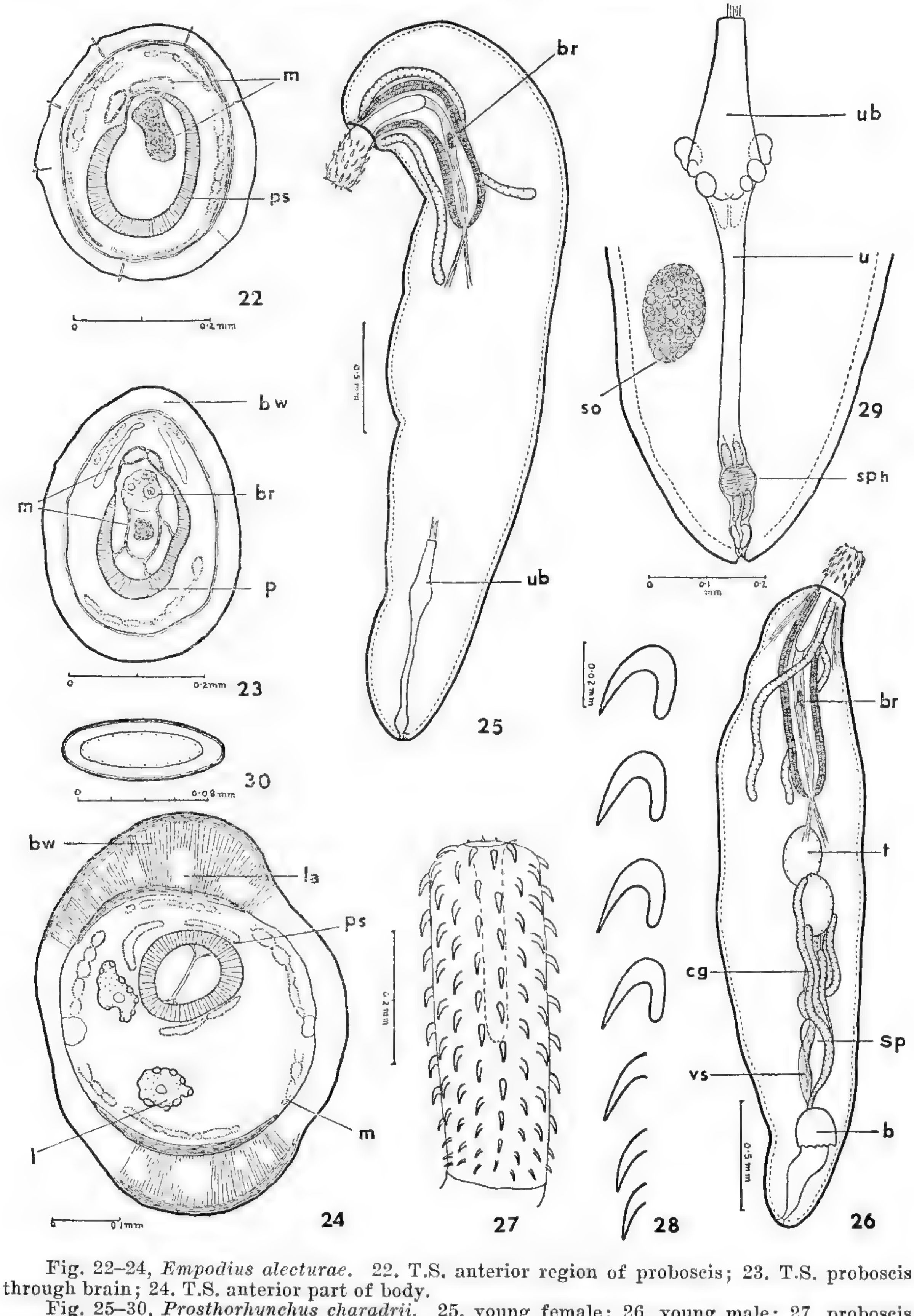

Fig. 22–24, *Empodius alecturae*. 22. T.S. anterior region of proboscis; 23. T.S. proboscis through brain; 24. T.S. anterior part of body.

Fig. 25–30, *Prosthorhynchus charadrii*. 25. young female; 26. young male; 27. proboscis (partly invaginated); 28. proboscis hooks; 29. female complex; 30. immature egg.

can be made out in a few of the worms. Two well developed lateral uterine pouches, in most cases containing eggs, come off laterally from the anterior end of the female complex and project towards the anterior end of the worm. The uterus is short and stout, its maximum dimensions being, length 0·92 mm. and breadth 0·45 mm. The female aperture is terminal. Ripe eggs are from 88 to 93μ long and from 40 to 43μ wide and are without polar prolongations (fig. 21).

Systematic Position. This parasite is considered to be a new species of the genus *Empodius*, family Gigantorhynchidae. It shows many resemblances to *E. taeniatus* (von Linstow 1901), but differs from the latter in length, in the number and arrangement of the proboscis hooks, and in the size of the egg.

PROSTHORHYNCHUS CHARADRII Yamaguti 1939.

Fig. 25–30.

A number of male and females of an echinorhynch, which we consider to be juvenile specimens of the above species, were found in the intestine of the bird, *Charadrius cucullatus*, collected by Prof. J. B. Cleland at Waitpinga, South Australia. The animals are small and cylindrical and the larger females in most cases are curved ventrally towards the posterior extremity. The body of both sexes is devoid of spines. The length of the males ranges from 1·8 to 3·2 mm., and the maximum width 0·50 to 0·66 mm. The length of the females ranges from 2·3 to 5·4 mm. and the width from 0·58 to 0·80 mm., all these measurements being made on specimens cleared in methyl salicylate. The proboscis, which is invaginated in all our specimens, is cylindrical and is borne at a slight angle to the rest of the body. Its maximum width ranges from 0·14 to 0·19 mm. and when fully everted, would be about 0·6 to 0·8 mm. long. The proboscis is armed with 17 longitudinal rows each of about 17 hooks, all of which, except the posterior three, have strong rooting processes. Their shape and size is shown in fig. 28. There is a short neck without hooks. The proboscis sheath is cylindrical and measures from 0·6 to 1·2 mm. in length and from 0·15 to 0·21 mm. in width. The sheath is double-walled and an elliptical brain is situated near its middle. There are two slender lemnisci which in most cases extend as far as the posterior end of the proboscis sheath.

Male System. Two elliptical testes are situated in the mid-region of the worm. They lie close together and are of approximately equal size, their length ranging from 0·16 to 0·25 mm. and their width from 0·12 to 0·17 mm. There are six long slender cement glands which are pressed together. Two of the glands reach as far forward as the anterior testes. Saefftigen's pouch is pyriform; there is a bursal cap; and the male aperture is terminal.

Female Complex. The shape and structure of the female apparatus are indicated in fig. 29. There is a well developed uterine bell, up to 0·36 mm. in length; a thin uterus, 0·5 mm. long; and a single-bulbed vaginal sphincter 0·15 mm. long. All our specimens are young, and though most of them contain swimming ovaries, none has ripe eggs. The youngest worms show that the ovarian balls arise near the base of the proboscis. The largest swimming ovary measured $0 \cdot 19 \times 0 \cdot 12$ mm., and the largest $93\mu \times 33\mu$. The posterior end of many females is slightly invaginated, the vaginal sphincter connecting with the anterior end of the invagination.

Systematic Position. We consider our specimens to be juveniles of *Prosthorhynchus charadrii* Yamaguti (1934, 334). The size of the proboscis, the number and arrangement of its hooks, and the general organization resemble those of the Japanese species which was collected from *Charadrius dubius curonicus* Gmelin. There is, however, a slight difference regarding some of the hooks. In Yamaguti's specimens all hooks except the posterior four in each row have rooting processes, whereas in ours all hooks except the posterior three in each row possess them. Yamaguti reported that the vaginal sphincter consisted of a double bulb, whereas in our material the structure is single-bulbed, but this condition may be due to immaturity.

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LARVAL TREMATODES FROM AUSTRALIAN FRESHWATER MOLLUSCS, PART XI

BY T. HARVEY JOHNSTON AND ANNE C. BECKWITH, UNIVERSITY OF ADELAIDE

Summary

Earlier papers in this series have been published in the Transactions of the Royal Society of South Australia, 1937-1945. The present contribution deals with the morphology of the cercaria and metacercarcia, obtained experimentally, of two Strigeate trematodes, as yet unrecognized as adults. The cercariae were obtained from gastropods living in the swamps of the lower Murray River, South Australia. These are: (1) Cercaria lessoni n. sp., from Planorbis isingi Cotton, Limnaea lessoni Deshayes, and Simlimnea subaquatilis Tate; the metacercarial stage occurring in freshwater leeches, Glossiphonia spp.; the adult being probably an Apatemon. (2) Cercaria ameriannae n. sp. from Amerianna pectorosa Conrad; the metacercaria occuring in tadpoles of Limnodynastes sp. (experimental) and, precociously, in Amerianna pectorosa; the unrecognized adult being a Diplostome, perhaps a Tylodelphys.

LARVAL TREMATODES FROM AUSTRALIAN FRESHWATER MOLLUSCS, PART XI

By T. HARVEY JOHNSTON AND ANNE C. BECKWITH, University of Adelaide.

Fig. 1–18.

Earlier papers in this series have been published in the *Transactions of the Royal Society of South Australia*, 1937–1945. The present contribution deals with the morphology of the cercaria and metacercarcia, obtained experimentally, of two Strigeate trematodes, as yet unrecognized as adults. The cercariae were obtained from gastropods living in the swamps of the lower Murray River, South Australia. These are: (1) *Cercaria lessoni* n. sp., from *Planorbis isingi* Cotton, *Limnaea lessoni* Deshayes, and *Simlimnea subaquatilis* Tate; the metacercarial stage occurring in freshwater leeches, *Glossiphonia* spp.; the adult being probably an *Apatemon*. (2) *Cercaria ameriannae* n. sp. from *Amerianna pectorosa* Conrad; the metacercaria occuring in tadpoles of *Limnodynastes* sp. (experimental) and, precociously, in *Amerianna pectorosa;* the unrecognized adult being a Diplostome, perhaps a *Tylodelphys.*

We desire to acknowledge our indebtedness to Messrs. G. G., F., B., and D. Jaensch of Tailem Bend, L. Ellis of Murray Bridge, and W. McAnaney of Lake Alexandrina, for assisting us in obtaining the molluscan material; and to the Commonwealth Research Grant to the University of Adelaide for financial support. Type material has been deposited in the South Australian Museum.

Cercaria (Furcocercaria) lessoni n. sp.

(Fig. 1–11.)

A small furcocercaria, *Cercaria lessoni,* has been obtained on a number of occasions from three different species of gastropods, *Planorbis isingi, Limnaea lessoni,* and *Simlimnea subaquatilis.* Eighteen collections of *P. isingi* from the River Murray swamps at Tailem Bend, were made between April, 1937, and February, 1941; the snail was not found again until December, 1945, when it reappeared in large numbers. Further collections of that species were made in January, March and May, 1946, making a total of 3,854 specimens of *P. isingi* collected on all occasions, of which 49 showed infection with *C. lessoni,* i.e. a 1·2 p.c. infection. The rate of infection in *Limnaea lessoni,* as shown by our figures, is a little higher; out of 3,736 snails collected on 43 separate excursions between December, 1937, and May, 1946, 112 specimens gave off *C. lessoni,* i.e. a

2·9 p.c. infection. Two of these collections were made at Swan Reach, the cercaria being obtained on both occasions. *S. subaquatilis* has been found by us in the River Murray swamps only twice: viz. once at Lake Alexandrina, when one out of 208 snails was infected; and once at Tailem Bend, when one out of 46 snails was infected.

The detailed studies have been made entirely with cercariae from *P. isingi*; the larvae from the other hosts were identified later as *C. lessoni* by microscopical examination and measurement.

The cercariae are emitted mainly during the morning, few appearing in the afternoon; the length of life is short, for all are dead within twenty-four hours of emission. The cercariae are actively swimming more than half the time; when resting they are suspended in the water with the furcae spread at an angle of 180°. When few cercariae are present—as in the infections of *P. isingi*, a very small snail—they tend to collect at the bottom of the tube, i.e. the darkest part; in this they resemble *C. pseudoburti* Rankin, which is said (Rankin 1939, 88) to be negatively phototropic. However, infections of *L. lessoni*, a much larger snail, are usually so heavy that a whole test-tube of water may be rendered opaque by the numbers of cercariae emitted within a few hours. The larvae swim with characteristic furcocerarial movement, tail-first, and, if the tube is shaken, vertically upwards. On one occasion two cercariae were observed attached to each other and swimming actively; one was caught on the spines of the other's everted ventral sucker.

For measurement cercariae were fixed by the addition of an equal quantity of boiling 10 p.c. formalin to the water in which they were swimming. Measurements were made with an ocular micrometer, in a water mount, using coverslip pressure only sufficient to keep the cercariae in one plane without distortion. The averages of measurements of ten cercariae, with the range of measurements in brackets, given in micra, are as follows: body length 110 (82–151); body breadth at widest part 31 (27–45); length of tail stem 90 (75–104); breadth of tail stem at widest part 25 (21–28); furca, length 101 (86–113); furca, breadth at widest part 19 (18–21); length of anterior organ 23 (19–27); breadth of anterior organ 18 (16–19); length of ventral sucker 18 (16–19); breadth of ventral sucker 15 (12–18).

In life, the shape of the body varies greatly with the state of contraction, being sometimes squat and nearly round, and at other times greatly elongate (fig. 5). There are no special oral spines. There is a cap of about eight rows of fine spines over the anterior organ, followed by about a dozen irregular rows of smaller spines, the last at the level of the oesophagus (fig. 1). The rest of the body is spineless except for a narrow band of irregularly scattered small spines

round the posterior end of the body. No such band is recorded for the related *C. burti* Miller, nor for *C. helvetica XXXI*, in which cercariae the spination is otherwise similar. The ventral sucker is beset with two or three concentric rings of spines alternately arranged and too numerous to count accurately. The opening of the ventral sucker is small and round and leads into a wider bowl-like cavity around the base of which the spines are situated. When the ventral sucker is greatly protruded, the spines are everted through the small aperture and in this condition are at right angles to the body of the cercaria.

The anterior sucker is strongly protrusible; the mouth opening may be inverted deeply into it, or pushed forward when the anterior organ is protruded. The straight narrow prepharynx leads into a well developed pharyngeal bulb. The rest of the digestive tract is difficult to see. Just anterior to the ventral sucker the narrow oesophagus bifurcates into two short deeply constricted caeca, the last lobes of which appear to be completely separated from the rest of the intestine. This condition resembles that described by Sewell (1922, 277) for *C. indica XXII*, by Miller (1926, 43) for *C. burti*, and by Wesenberg-Lund (1934, 114) for *C. longiremis*. The ends of the caeca, which scarcely extend beyond the posterior border of the ventral sucker, stain with intra-vitam neutral red, but not with intra-vitam Nile blue sulphate.

Dorsal to the caeca on either side lie four small granular penetration cells (fig. 1) one behind the other, the first antero-lateral to, the last postero-lateral to the ventral sucker. The cells stain deeply with Nile blue sulphate, lightly with neutral red in strong solution, and are unstained in Orange G solution. The cells are granular with large, clear, non-staining nuclei. The proximal part of each duct is granular, the rest clear; they pass forward to penetrate the anterior organ laterally and open on either side of the mouth. The gland-cells are difficult to see in living specimens except when deeply stained; in this respect they are apparently similar to those of *C. helvetica XXXI* which Dubois (1929, 94) described as "peu distinctes." In preserved specimens the gland-cells stained with neither acid alum carmine nor Delafield's haematoxylin. Antero-lateral to the ventral sucker on each side is a clear roundish refractory body (fig. 1), which did not stain with any stain used. These bodies are apparently "unpigmented eyespots," such as those described for *C. pseudoburti* by Rankin (1939, 89) and for *C. ranae* by Cort and Brackett (1938, 264).

A thick band of nerve fibres staining with intra-vital Nile blue sulphate lies dorsal to the oesophagus just behind the pharyngeal bulb (fig. 1). The genital primordium is a mass of cells staining deeply with acid alum carmine and Delafield's haematoxylin; it lies between the ventral sucker and the bladder (fig. 1).

The tail is longifurcate, with a border of fine, short spines along each side of

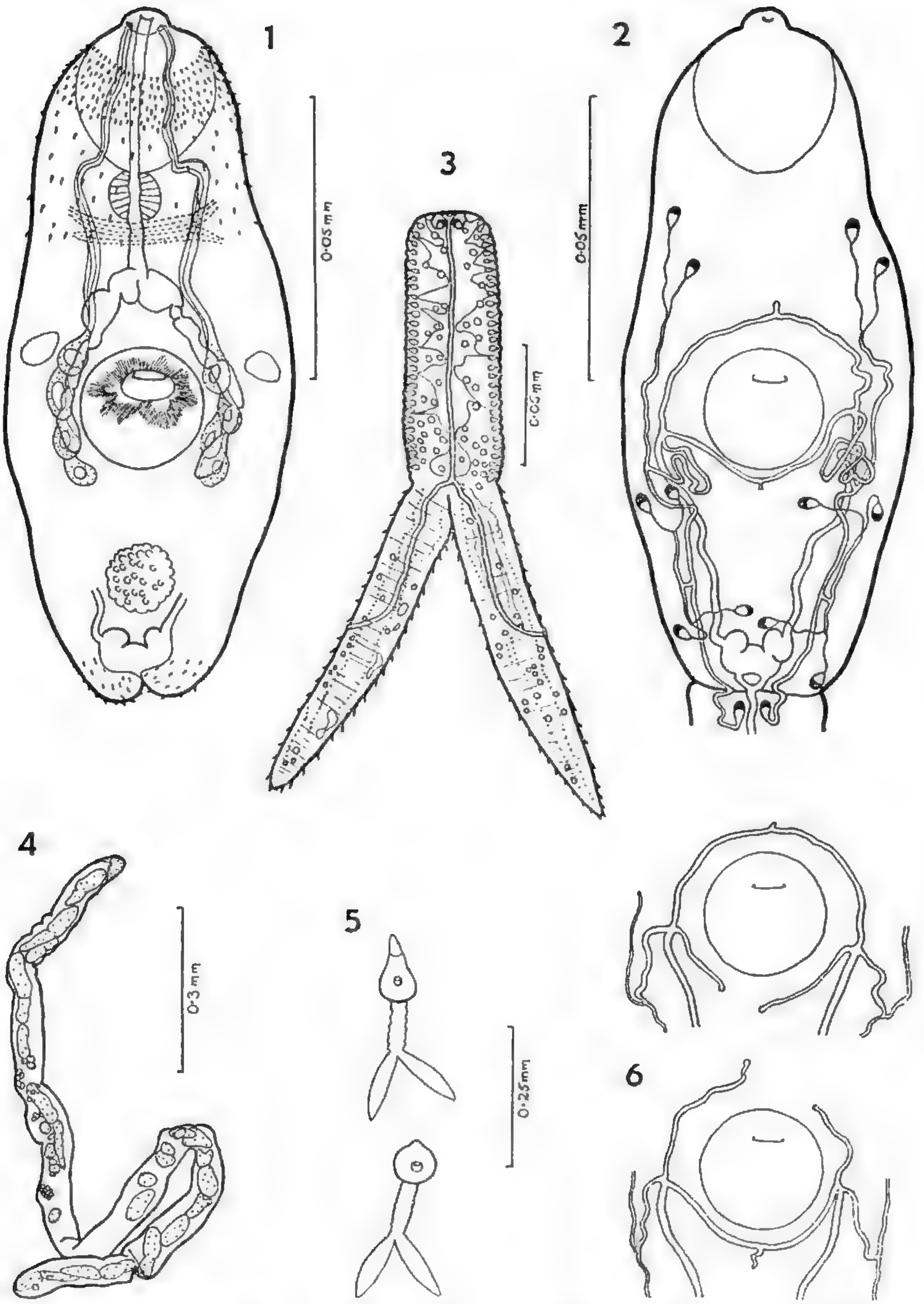


Fig. 1–6, *Cercaria lessoni.* 1. glandular, nervous, digestive and reproductive systems, and spination; 2. excretory system; 3. tail; 4. sporocyst; 5. showing different shapes assumed according to the state of contraction; 6. two variations in the excretory commissures. Outlines of fig. 1–5 drawn with camera lucida; fig. 6 drawn freehand.

the furcae (fig. 3). There are five or six irregular pairs of large clear cells, variable in shape, within the tail-stem. These "caudal bodies" are anchored to the sides of the tail-stem by fine strands of tissue, and are also attached to the central excretory canal of the tail. Numerous small stalked cells line the sides of the tail-stem, their bodies projecting inwards and moving freely. Longitudinal and transverse muscle fibres are well-developed.

The body of the bladder (fig. 2) is rounded, with a bulge on either side from which the main collecting tube passes forward to the level of the posterior border of the ventral sucker. Here it takes a sharp bend posteriad, continuing for a short distance as a greatly convoluted tube which receives two secondary tubules, one from the anterior part of the body, draining one pair of flame-cells, the other from the posterior part of the body, draining two pairs of flame-cells in the body and a single flame-cell in the anterior extremity of the tail-stem, the formula being $2[(2) + (2 + 2 + (1))] = 14$.

Where the main excretory tube bends posteriad, it receives two transverse commissures, one anterior to, the other posterior to, the ventral sucker. The extent to which these commissures are developed varies considerably in different specimens. The commissures arise as a pair of branches growing out from the main excretory duct on either side, at the point where this duct turns posteriad. The posterior branch from each side grows towards the mid-line; the anterior pass forward by the side of the ventral sucker before growing inward to meet. In any one cercaria, both pairs of commissural outgrowths, or one only (either the anterior or the posterior), or neither, may meet and fuse, the point of fusion being as a rule the point of origin of a short, blindly-ending vessel. Thus four stages of fusion have been observed, and in cases where fusion has not occurred, the degree of development of the commissures is very variable (fig. 6).

Posterior to the bladder is an island of Cort, and from this the excretory canal of the tail passes posteriad along the tail-stem, branching at the origin of the furcae into two tubes, each of which opens by a pore to the exterior halfway along the anterior border of the furca.

SPOROCYST.

Upon dissection of a host *Planorbis,* the liver was found to be almost completely replaced by narrow, elongate, colourless sporocysts with rounded ends (fig. 4). The length of the longest sporocyst dissected out entire was 3 mm. (preserved in formalin), i.e. they are relatively small. No birthpore was observed; cercariae and germ-balls are scattered without order along the length of the parasite. The wall of the sporocyst is studded with cells which stain with haematoxylin; the cuticle is yellowish and faintly wrinkled. Living sporocysts are capable of slight movement.

Sporocysts taken from the liver of *L. lessoni* infected with *C. lessoni* were similar, but were present in far greater numbers as the latter snail is many times larger than *P. isingi*, and is subject to very heavy infestations with this parasite.

METACERCARIA.

Attempts have been made to infect with *C. lessoni*, the fish *Gambusia affinis* and *Carassius auratus*; tadpoles (*Limnodynastes* sp. and *Hyla peroni*); molluscs (*Amerianna* spp., *Limnaea lessoni*, *Planorbis isingi*); the yabby (*Cherax destructor*); and mosquito larvae. None of these attempts was successful. On two separate occasions, about six weeks apart, two leeches (*Glossiphonia* sp.) were both exposed to fairly heavy infections; seven weeks after the second exposure the leeches were dissected. Both contained a large number of thick-walled cysts, of two sizes, embedded in the tissues of the body wall. As the leeches used had been taken from the River Murray, and had thus been exposed to the possibility of natural infection, the results of the experimental infection are open to question; but the occurrence of the cysts in two sizes, corresponding with the two infections, and the large number recovered, indicate that they were the result of experimental infection. The same sort of cysts were recovered from a similar leech exposed to infection with cercaria from the other host, *Limnaea lessoni*.

The cysts (fig. 8) are thick-walled and slightly egg-shaped. The measurements (in micra) of a cyst of the smaller size, are as follows: length of cyst, 295; breadth of cyst, 246; length of cavity of cyst, 205; breadth of cavity, 180. Measurements of a cyst of the larger size are: length of cyst, 393; breadth, 328; length of cavity, 278; breadth 246.

The thickness of the cyst wall made the excystment of the living metacercaria unfeasible by ordinary mechanical methods; so a solution of pepsin in 0·4 p.c. hydrochloric acid, warmed slightly, was used to dissolve the cyst wall and liberate the metacercaria. Although this ensured that undamaged metacercariae were obtained, none remained alive long enough to facilitate study of the excretory system, so that only the grosser features were seen (fig. 7). Further study was made using preserved specimens, stained with neutral red and examined in a serum mount, or stained with Delafield's haematoxylin and examined in methyl salicylate mounts.

The metacercaria is a Tetracotyle, fairly active in life, especially when warmed slightly, as in the process of dissolving the cyst. In a cyst under coverslip, most of the anatomical features of the larva can be seen, although the proportions of the body cannot be determined (fig. 10). In an excysted metacercaria

(fig. 7 and 9), the bipartite nature of the body is obvious, the posterior part containing the genital primordia being much smaller than the anterior containing the organs of adhesion. These comprise two lateral suctorial cups (fig. 7),

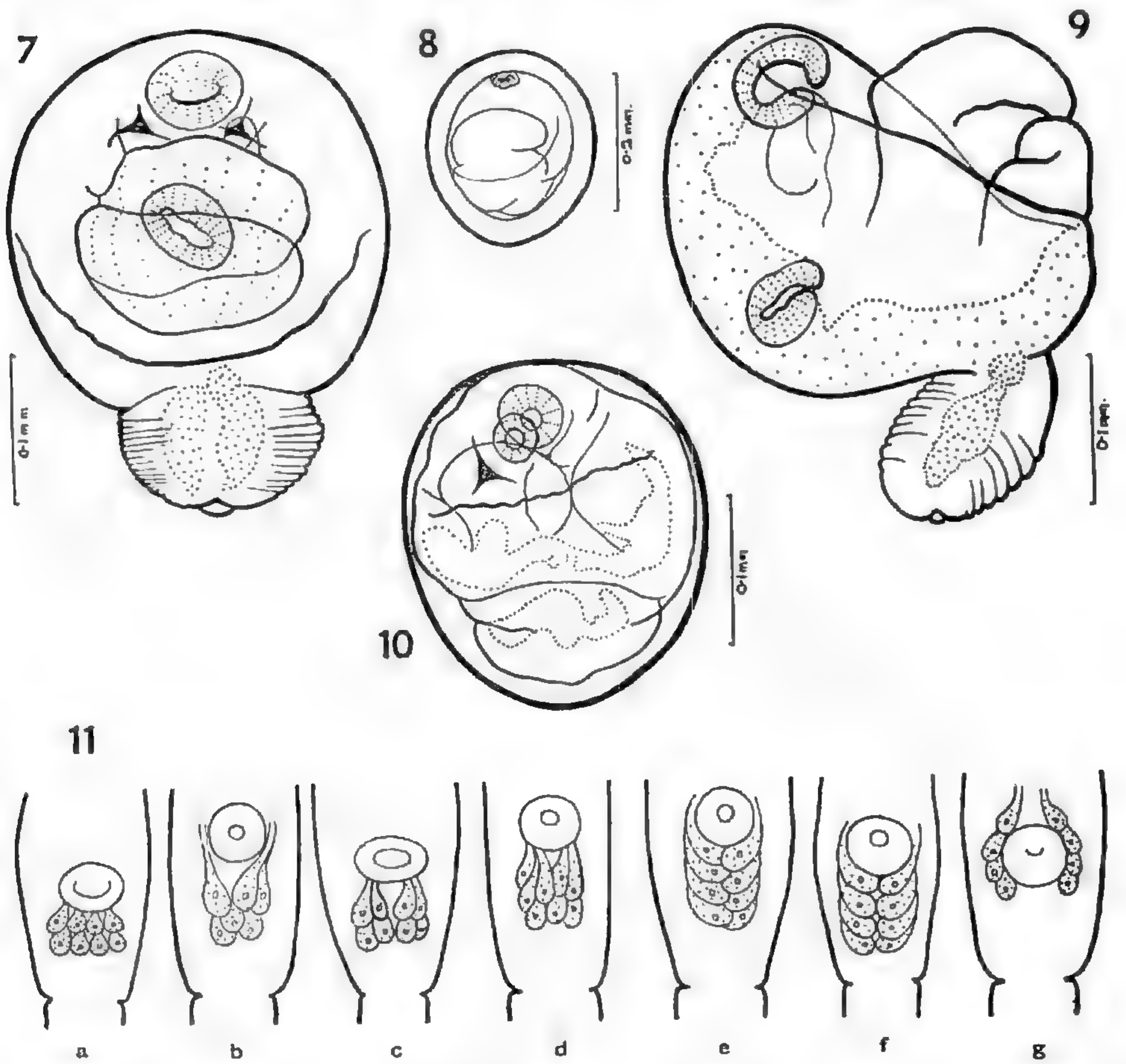


Fig. 7–11, *Cercaria lessoni*. 7. metacercaria freed from cyst, ventral view; 8. cyst; 9. metacercaria, lateral view; 10. metacercaria within cyst, ventral view (inner wall only of cyst shown); 11. a number of *Apatemon* cercariae arranged in series according to the disposition of the gland-cells—a, Cercaria of *Apatemon gracilis* (after Szidat); b, *C. riponi* (after Brackett); c, *C. pseudoburti* (after Rankin); d, *C. burti* (after Miller); e, *C. helvetica XXXI* (after Dubois); f, *C. pygocytophora* (after Brown); g, *C. lessoni*.

and two large suctorial lips enclosed in a ventral pocket. The anterior and ventral suckers are well-developed. A pharynx was not seen, but in figures of the closely similar Tetracotyle of *Apatemon gracilis*, described by Szidat (1931, 143–4), a very faint pharynx is indicated.

RELATIONSHIPS.

Cercaria lessoni is a longifurcate, distome, pharyngeal cercaria whose nearest relative is *C. helvetica XXXI* (Dubois, 1929) from *Limnaea* and *Planorbis*. The measurements of the latter (body length, 120–140; tail-stem, 135–155; furca length, 160–180) show it to be a little larger; but it is characteristic of this type of cercaria is to be "very contractile" (Dubois 1929, 95), as the range of measurements of *C. lessoni* indicate, so that this difference is probably of little importance, especially as Dubois' method of fixing cercaria may have been different from ours. The shape and proportions of the body are closely similar; the excretory systems are identical, except that, in *C. lessoni*, the commissures are not always completely developed, and that the flame-cells in the caudal stem are placed higher than those of Dubois' cercaria. The nature of the intestinal caeca is apparently the same in both; those of *C. lessoni* were exceedingly difficult to see, and Dubois was unable to follow those of *C. helvetica XXXI* to their termination. The most conspicuous difference is in the gland cells; in Dubois' cercaria they are disposed in two longitudinal series, each of four cells, posterior to the ventral sucker, and are somewhat larger than those of *C. lessoni;* while in the latter, the two longitudinal series have become pushed forward and lie on either side of the ventral sucker. The gland cells of both have the same character, however, being very indistinct. The only other differences are: firstly, that unpigmented eyes are not recorded for Dubois' cercaria, but these are in any case not conspicuous features; secondly, that no mention is made of minute scattered spines around the posterior part of the body, as in *C. lessoni;* and finally, that no island of Cort is indicated, but this again is a very inconspicuous feature.

Another cercaria, *C. pygocytophora* Brown (1931), from *Planorbis*, is very closely allied to *C. helvetica XXXI*, and to *C. lessoni*. The flame-cell formula is the same, and spination, caudal excretory system, body size and shape are all practically identical with those of the other two cercariae. The glands, eight in number, are arranged like those of *C. helvetica XXXI.* Apart from the latter difference, the only other distinctions between *C. pygocytophora* and *C. lessoni*, are the presence of hair-like structures on the tail-stem of the former, and the nature of its excretory commissures. The latter are apparently rather less completely developed even than those of *C. lessoni;* no trace of a posterior commissure is shown, while the branches of the anterior have not met in the cercarial stage.

But for the presence of the commissure anterior to the ventral sucker, *C. lessoni* resembles closely another group of cercaria, which includes the cercaria of *Apatemon gracilis* (from *Bithynia*), *C. burti* Miller (from *Limnaea* and *Planorbis*), and *C. pseudoburti* Rankin (from *Limnaea*). These have only one

commissure behind the ventral sucker, but have an excretory formula identical with that of *C. lessoni*. The size, shape, proportions and spination are similar. All have four pairs of penetration glands, but these are behind the ventral sucker, arranged either in two horizontal rows, as in the cercaria of *Apatemon gracilis*, or in two groups of four, as in the others. Long, fine hair-like processes, like those of *C. pygocytophora*, are shown on the sides of the tail-stem of the cercaria of *A. gracilis*, but no such processes were observed on *C. lessoni*. Eyes are not recorded for *C. burti*. *C. pseudoburti* is very similar to *C. lessoni*, but in the former, the lack of anterior commissure, the absence of spines at the posterior end of the body, as well as the disposition of the gland-cells, serve to distinguish it from our cercaria.

To this group might be added *C. riponi* Brackett, 1939 (from *Stagnicola*) which agrees with the descriptions of the others, except that the glands, arranged like those of *C. burti* and *C. pseudoburti*, in two groups behind the ventral sucker, are given as only six in number. If these glands are of the same indistinct nature as those of *C. helvetica XXXI* and *C. lessoni*, the difficulty encountered in distinguishing the precise number would be considerable.

A number of other cercariae appear to have some affinities with *C. lessoni*, though not so closely related as the six mentioned above. The cercaria of *Apharyngostrigea pipientis* Olivier (1940), from *Planorbula*, has eyespots and four pairs of gland-cells rather like those of our larva; it also has two excretory commissures, though their relation to the rest of the excretory system is different. The excretory system formula is $2[(2+2)+(2+2+(2))]=20$, i.e., it shows development of a greater complexity with the same pattern as that of *C. lessoni* and its closest relatives. In this connection it is interesting to note that the flame-cells in the tail of the cercaria of *A. pipientis* are in the same position as those of the other group, and that the two flame-cells of each side are very closely connected, as though their division is very recent. The size of the cercaria is of the same order, but it is very obviously distinguished from *C. lessoni* by the peculiar nature of its tail, as well as by minor features such as spination.

The cercaria of *Apharyngostrigea ibis* Azim 1935 (from *Planorbis*, *Physopsis* and *Pyrgophysa*) is less similar to *C. lessoni* in some respects than the cercaria of *A. pipientis*. The shape and size of the body are of the same order, and the spination probably similar, though the hair-like processes on the tail are a distinction, and no pharynx is shown in Azim's figure. There appear to be, not four, but three pairs of gland cells arranged as in the cercaria of *A. pipientis*. The furcal excretory tubes open at the tips of the furcae, unlike those of *C. lessoni* and the related forms; the excretory system, so far as can be determined from the diagram, possesses no commissures; and though the flame-cells are fourteen in

number, with two single flame-cells in the tail stem, the formula is different from that of *C. lessoni*. The metacercaria of both these forms is found in tadpoles.

C. dohema Cort and Brackett (hosts, *Stagnicola* and *Limnaea*) resembles our cercaria in size, spination, presence of eyespots and a posterior excretory commissure, and in the excretory tubes of the tail, which open half-way along the furcae; but the excretory system though of the same fundamental pattern, is less complex, its formula being $2[2 + (2 + (1))]$; there are only six glands lying behind the ventral sucker; the digestive system is greatly reduced. *C. angelae* Johnston and Simpson 1944 (from *Amerianna*), has somewhat similar spination, two groups of four gland-cells, in tandem, an excretory commissure behind the ventral sucker, and a single pair of flame-cells high in the tail stem; but the grouping of the flame-cells in the body is different, and the furcal excretory tubes open at the tips. The excretory system of *C. bulbocauda* Miller (from *Planorbis*) appears to be identical with that of *C. lessoni*, but the nature of the tail and digestive system excludes it from immediate relationship. *C. hirsuta* Miller and *C. granula* Miller (both from *Planorbis*) exhibit some features in common with our cercaria, including excretory systems of similar but not identical formulae; but both forms possess a greatly reduced digestive system, and a very large number of small glands behind the ventral sucker.

C. furcicauda Faust, *C. robusticauda* Faust, and the cercaria of *Neodiplostomum lucidum* (La Rue and Bosma) have each a single flame-cell pair high in the tail, and excretory pores halfway along the furcae, but in none of these three is the arrangement of the flame-cells exactly similar to that of *C. lessoni*, while the absence of a posterior commissure, and the number and arrangement of the gland-cells, indicate that, though some relationship is possible, it is not close.

C. gracillima Faust (from *Physa* and *Limnaea*), *C. bdellocystis* Lutz (from *Planorbis*) and *C. longiremis* Wesenberg-Lund (from *Valvata*) may be related species, but the descriptions are inadequate to verify this. *C. bdellocystis* is said to encyst in leeches and develop into *Apatemon bdellocystis* (in pigeons, experimentally).

Furcocercaria I Petersen (from *Limnaea* and *Physa*) has two groups of three gland-cells, and an excretory commissure posterior to the ventral sucker; the body proportions, spination and contractility are similar to *C. lessoni*, but the excretory system as indicated in the diagram shows a number of differences. *C. secobii* Faust (from *Limnaea* and *Physa*) has four pairs of gland-cells in tandem but, though the excretory system is not known, the large size of the tail makes close relationship with *C. lessoni* improbable.

C. ranae Cort and Brackett has eyespots and a commissure more or less behind the ventral sucker, but is distinguished from our cercaria by the gland-

cells, spination, and the flame-cell formula. *C. obscurudena* Brackett has only a single pair of flame-cells high in the tail-stem, but the rest of the excretory system and gland-cells exclude it from close relationship.

C. indica I Sewell (from *Indoplanorbis*) possesses spination and a caudal excretory system like that of *C. lessoni*, but the body excretory system differs somewhat, there is no posterior commissure, and there are only two pairs of gland-cells before the ventral sucker. Concerning *C. indica XXII*, Sewell mentioned the curious nature of the intestinal caeca, a feature characteristic of *C. lessoni;* it is, however, the only feature they have in common, for *C. indica XXII* has four flame-cells, well-spaced out, in the caudal trunk—a characteristic of *Cotylurus* and Diplostome cercariae, and very different from the condition in *C. lessoni* and its closest allies.

DISCUSSION.

It is apparent that the affinities of *C. lessoni* are mainly with the six cercaria first mentioned, i.e. *C. helvetica XXXI*, *C. pygocytophora*, the cercaria of *Apatemon gracilis*, *C. burti*, *C. pseudoburti*, and perhaps *C. riponi*. In 1938, Willey and Rabinowitz (1938) proved *C. burti* to be the larva of *Apatemon globiceps*, the metacercaria being a Tetracotyle occurring in leeches. The metacercariae of *C. helvetica XXXI*, *C. pseudoburti*, *C. pygocytophora* and *C. riponi* have not been described, though it is known that *C. pseudoburti* does not encyst in nymphs of mayflies and dragonflies, gammarids, tadpoles, fish or mice. Dubois, in discussing the genus *Apatemon* (1938, 96) mentioned *C. helvetica XXXI* as an *Apatemon* larva distinct from that of *A. gracilis*, whose cercaria was at that time known, and whose tetracotyle had been described from leeches by Szidat (1929; 1931). Lutz's *Dicranocercaria bdellocystis* (1934) appears to be a further example of an *Apatemon* cercaria encysting in leeches. Although no other complete life cycles have been established for the genus *Apatemon*, two other *Apatemon* metacercaria have been described from fish—the tetracotyle of *Apatemon fuligulae* by Yamaguti, encysting in Siluridae, and the tetracotyle of *A. pellucidus*, encysting in *Mogurnda*.

The cercariae listed above, together with *C. lessoni*, form a particularly well-defined group of seven cercariae (if *C. riponi* is included) so closely allied that their differences are unlikely to be more than inter-specific. As a group, these "*Apatemon* cercaria" are characterized by certain features which distinguish them clearly from cercariae of related genera, such as those of *Cotylurus* and *Diplostomum*. The *Apatemon* cercariae are extremely small and very active. The body is characteristically pear-shaped, but may assume a variety of forms because of the remarkable contractility of the body; both Miller (1926, 41) and Dubois (1929, 95) comment on the great extensibility of the forms they describe.

The spination is sparse, mainly confined to the anterior part of the body. The pharyngeate alimentary canal ends in caeca which are short, faint and may be lobed. The penetration glands are eight in number, except in the doubtful *C. riponi*; these glands are usually behind the ventral sucker. The variations in their arrangement constitute an important means of species identification. When arranged in order according to the disposition of their gland-cells, the cercariae form a fairly definite series, from the cercaria of *Apatemon gracilis*, with glands in two horizontal rows, through *C. pseudoburti* and *C. burti*, with glands more longitudinally disposed in clusters, to *C. helvetica XXXI*, *C. pygocytophora* and *C. lessoni*, in which the glands have become drawn out into two longitudinal rows (fig. 10).

Perhaps another characteristic of the *Apatemon* cercariae is the presence of unpigmented eyespots, though they are not described in all. The tail is always longifurcate; the tail-stem, body and furcae are of much the same length in each cercaria. The flame-cell formula is $2[2 + (2 + 2 + (1))] = 14$. The presence of only two flame-cells in the tail-stem, instead of four, as is usual in *Cotylurus* and Diplostome cercariae, and their position immediately behind the junction of body and tail is an invariable feature. Sewell (1922, 267) in discussing *C. indica I*, sole member of his *Pahila* group, considers that the presence of a single flame-cell pair in the tail-stem is probably a group character rather than a specific difference, a view which this set of cercariae tends to support; but the feature also characterizes another group, Miller's *Elvae* group of ocellate cercariae, which are not otherwise closely related, as well as various other cercariae, mentioned above, which are not closely allied to the *Apatemon* cercariae. This character is hence merely indicative and not diagnostic until considered with the other special features. Likewise, the position of the excretory pores of the tail, half-way along the furcae, is typical not only of the *Apatemon* cercariae, but also of many *Cotylurus* and *Diplostomum* cercariae.

The early development of parts of the reserve excretory system is a further characteristic of the *Apatemon* cercariae. This allies them to the *Cotylurus* group, in contrast with the Diplostome cercariae. In the former, the commissure usually developed is that anterior to the ventral sucker; in the *Apatemon* group, four of the seven cercariae possess one commissure, posterior to the ventral sucker, while the other three (*C. helvetica XXXI*, *C. pygocytophora* and *C. lessoni*) display variability in the extent to which the commissures are developed. *C. helvetica XXXI*, the most precocious, has two fully developed commissures; *C. pygocytophora* shows least development, with only an anterior commissure, incompletely developed; while in *C. lessoni* growth and fusion of the two commissures takes place to a variable extent in cercarial life. Precocious development of the reserve system has been observed in a number of cercariae, e.g. *C. sanjuanensis* Miller, in which

blind tubes arise from the commissure. Olivier (1940, 463), in mentioning the well-developed commissures in the cercaria of *Apharyngostrigea pipientis,* points out that "the presence or absence of transverse commissures in cercaria simply indicates differences in the rate of development of their respective excretory systems." The differences in rate of development are, however, group characteristics and are useful diagnostically; and Dubois (1944, 81) states that the diverse genera of Cotylurini and Strigeini represent forms more highly evolved than the Diplostomini, since in the former, the anastomosing processes have already appeared in the cercaria, while in the latter, they are only developed in the metacercaria.

Finally, *Apatemon* cercariae are limited in their host range to species of *Limnaea, Planorbis* and *Stagnicola,* except for the cercaria of *A. gracilis,* whose host is *Bithynia*; and the metacercaria is a Tetracotyle which forms a thick-walled, slightly oval cyst.

We may point out that a species of *Apatemon, A. intermedius* (S. J. Johnston) Dubois, has been described from the black swan, *Chenopis atrata,* which is a common bird on the Murray swamps.

CERCARIA (FURCOCERCARIA) AMERIANNAE n. sp.

(Fig. 12–18.)

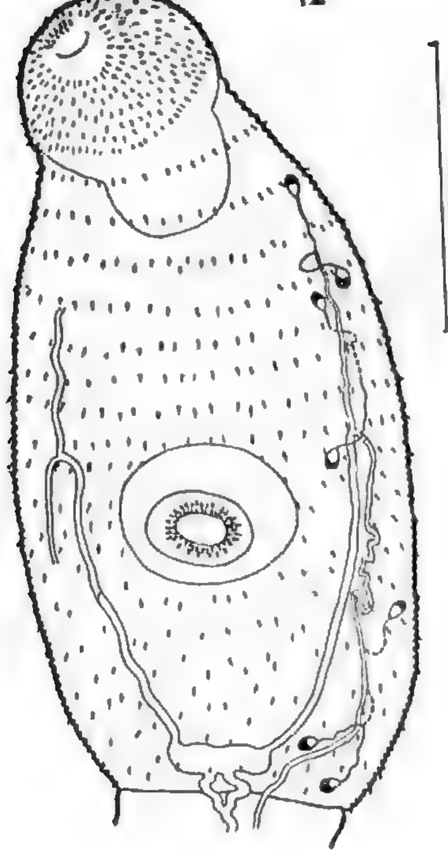
A new cercaria, *C. amerianuae* has been obtained on two occasions only, in both cases from *Amerianna pectorosa* collected from the Murray swamps at Tailem Bend. It was found in one of 166 *Amerianna* spp. collected in October, 1944, and in one of 400 in December, 1946. It is evidently a rare larva in that locality since it has not been observed on any other occasion during our ten-year survey of the molluscan parasites of the region.

The cercariae are emitted mainly during early morning. They are not particularly active, spending most of the time suspended in the water with the furcae spread at about 180°. They swim in characteristic furcocercarial fashion. The length of life was not determined.

The averages in micra, of ten measurements, based on specimens fixed as indicated earlier, followed by the range in brackets, are as follows: length of body, 209 (180–229); breadth of body at widest part, 40 (30–49); length of tail-stem, 259 (229–295); breadth of tail-stem at widest part, 34 (32–41); length of furca, 243 (131–287); breadth of furca at widest part, 20 (16–32); length of anterior organ, 45 (37–59); breadth of anterior organ, 29 (27–32); length of ventral sucker, 22 (21–27); breadth of ventral sucker, 22 (19–27).

In life, the body when greatly contracted (as in specimen drawn in fig. 12),

12



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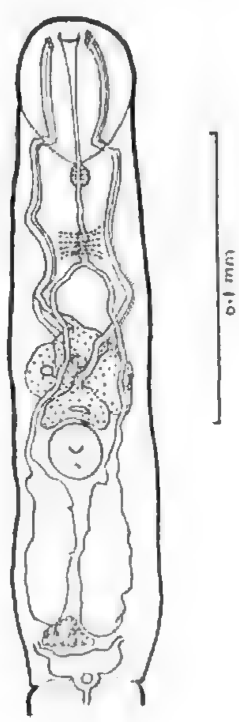

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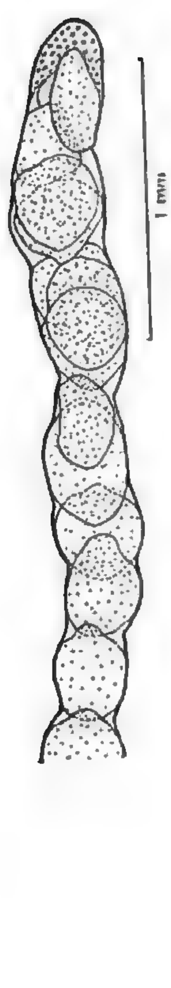

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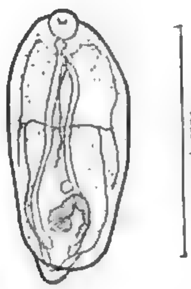

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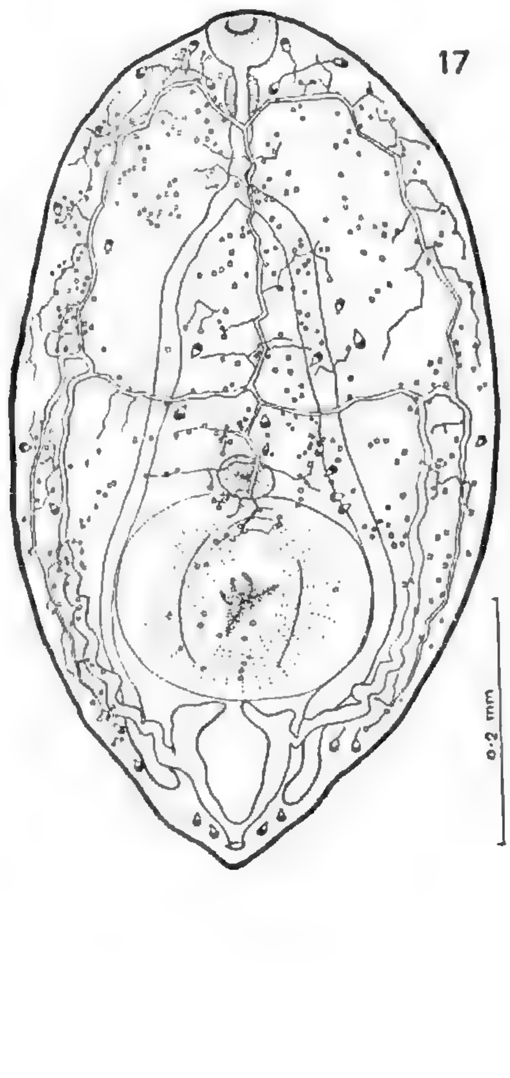

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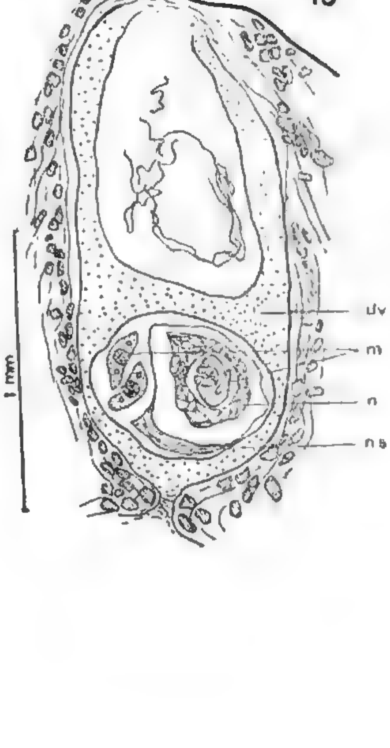

is striated transversely by wrinkles, but these disappear when the body is extended, as in fig. 13.

In front of the mouth are about thirteen fine spines, arranged alternately in two rows (fig. 12). There is a small circumoral spineless area, followed by a wide collar of 9–10 rows of spines, covering the anterior organ. Behind this the body is entirely covered with spines, arranged in rows over the anterior half of the body, and irregularly scattered more posteriorly. The ventral sucker is beset with about seventy long slender spines arranged in two concentric rings. There is a single row of fine spines along each side of the furcae.

The mouth opening (fig. 13) may be pushed forward or withdrawn deep into the anterior organ. Behind the latter is a short prepharynx followed by a stout muscular pharynx, which is succeeded by a narrow oesophagus. The latter bifurcates to form the two very long intestinal caeca. These are more than half as long as the whole body; the longer anterior portion is narrow, but in the region of the ventral sucker they widen suddenly into two pouches which extend back to the anterior border of the bladder. The wide part of the caeca stains faintly with intra-vitam neutral red.

Immediately in front of the rather small ventral sucker, and ventral to the caeca, lie four large prominent penetration gland-cells, the cytoplasm of which stains with neutral red used intra-vitam. The highly characteristic arrangement of these is shown in fig. 13. The ducts of the four cells travel forwards, a pair on either side, and enter the anterior organ, the point of entry being marked by a constriction in their diameter. The ducts open beside the mouth.

Dorsal to the oesophagus, behind the pharynx, lies a transverse band of nervous tissue. The genital primordium consists of a small, more or less triangular mass of cells, situated between the ends of the caeca and the bladder.

The longifurcate tail is very large relative to the body (fig. 14); both tail-stem and furcae are longer than the body. The tail-stem is very muscular; it contains no caudal bodies.

The bladder is broad and slightly lobed at each lateral extremity. Each lobe receives a main collecting duct which passes forward, without coiling, to the level of the anterior border of the ventral sucker, where it receives two secondary tubules, an anterior, draining two pairs of flame-cells (fig. 12), and a posterior, draining a single flame-cell and one pair in the body, and a further pair, well

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Fig. 12–18, *Cercaria americannae*. 12. spination and excretory system of body; 13. glandular, nervous, digestive and reproductive organs; 14. general proportions of cercaria, and excretory system of tail; 15. part of a sporocyst; 16. metacercaria, uncompressed; 17. anatomy of metacercaria; 18. section through dorsal body wall of tadpole showing metacercariae in situ in the notochord. Outlines of all figures were drawn with a camera lucida.

dv = developing vertebra of tadpole; m = metacercaria; n = notochord; ns = notochordal sheath.

spaced out, in the tail-stem (fig. 14). The flame-cell formula is thus $2[(2+2)+(1+2+(2))]=18$. The posterior tubule is also furnished with two patches of cilia, just after its origin from the main duct. From the posterior border of the bladder the central excretory canal of the tail arises; it forms an island of Cort at the junction of body and tail-stem, and then passes down the tail-stem to divide at the origin of the furcae into two ducts. The opening of these, as far as could be determined from preserved material, probably occurs half-way along the furcae (fig. 14).

SPOROCYST.

The single host snail of this parasite lived in the laboratory for nearly three months. Upon death it was dissected; most of the liver had been replaced by masses of tangled, whitish sporocysts. The first attempt to disengage one of these liberated an immense number of actively moving diplostomula, and every sporocyst was packed with them (fig. 15), but no cercariae were seen, although the latter were being emitted only twelve days earlier. The sporocyst itself consisted of nothing more than a delicate tubular skin around the diplostomula. A long sporocyst measured 5 mm.; but most of them were shorter.

Precocious development of diplostomula within the parent sporocyst has been recorded for various species, including *C. metadena* Johnston and Angel (1942), observed in this laboratory. In the report on this observation, an account was given of other observations of this phenomennon, which is apparently confined to the Diplostomes, and also a discussion of the possible causes of such precocious development.

METACERCARIA.

The fish, *Gambusia affinis*, resists experimental infection with *Cercaria ameriannae*. Tadpoles of *Limnodynastes* sp., probably *L. dorsalis*, are however highly susceptible to infection. Two of these were placed in contact with large numbers of cercariae. On the following day both tadpoles were dead, and microscopical examination showed numerous tail-less cercariae moving through the tissues. Lighter infections employed subsequently enabled diplostomula of considerable size to be raised. They do not secrete a cyst wall, and for some time after penetration are to be found wandering in the tissues. Eventually they penetrate the notochord, and develop within it in numbers. Sections show that, where they penetrate, the notochord becomes hollowed out. Usually a group of about half-a-dozen are found together.

The diplostomula are very active when alive, and are very extensible—there may be a difference of 82μ between the length when extended and the length when

contracted. The averages of measurements of six preserved metacercaria, given in micra, with the range in brackets, are as follows: length of body, 377 (319–410); breadth of body at widest part, 221 (205–237); length of anterior organ, 36 (30–37); breadth of anterior organ, 34 (30–36); length of pharynx, 29 (28–30); breadth of pharynx, 25 (23–27); length of holdfast, 79 (63–95); breadth of holdfast(81 (66–90). The ventral sucker was not measured as it was very indistinct in most specimens. The six specimens measured were taken from a tadpole infected ten months previously.

When the diplostomulum is uncompressed (fig. 16), it may be seen that the body is composed of two portions, a large leaf-like anterior part, and a small posterior region. The anterior part is slightly concave ventrally and is furnished with a well-developed holdfast, beset ventrally with minute spines (fig. 17). The posterior part contains the bladder and genital primordium.

The anterior part has grown considerably more than has the acetabulum, which is situated immediately in front of the holdfast organ. The pharynx is stout and muscular, leading to a short oesophagus, followed by a pair of long slender caeca, extending to the posterior part of the body; the bulging ends, which characterized the cercarial stage, have not persisted.

The bladder is composed of two long horn-like branches, and has a single excretory pore on its posterior border. From each branch of the bladder a a stout collecting duct passes forwards on each side. Just in front of the level of the ventral sucker each duct receives a short collecting tube into which open, firstly, a posterior tubule, passing back to the level of the bladder and receiving numerous lateral capillaries; and secondly, an anterior tubule also draining numbers of capillary tubes; this anterior tubule passes forwards to the level of the pharynx where it bends mesiad and fuses with its fellow from the opposite side. From the point of fusion a central vessel passes posteriad, receiving many side-branches. In front of the ventral sucker it is joined by a commissure which passes from the branching end of one main collecting duct to the other. The central vessel continues posteriad to the region of the holdfast, where it ends in branches.

The flame-cells have increased considerably in number; a complete study was impracticable but the position of a number is indicated on the diagram. Numerous refringent excretory granules are present throughout the body, connected with the newly developed capillary channels of the excretory system.

RELATIONSHIPS.

C. amerinnae is a Strigeid larva of the longifurcate, pharyngeal, distome type. Since it possesses no excretory commissure, it is at once distinguished from the *Apharyngostrigea*, *Apatemon*, and *Cotylurus* cercariae; the only notable point

of similarity between *C. ameriannae* and most of the last-named group is the possession of four pre-acetabular gland-cells, and two pairs of flame-cells in the tail. This last characteristic distinguishes *C. ameriannae* at once from such cercariae as *C. indica I* Sewell, *C. furcicauda* Faust, and *C. Neodiplostomi-lucidi* (La Rue and Bosma), which, though possessing four gland-cells, have only two flame-cells in the tail, near the junction of the body.

Our cercaria is rather more closely allied to a number of cercariae which, besides possessing four gland-cells, have several other significant features in common with *C. ameriannae*. *C. chrysenterica* Miller, from *Limnaea megasoma*, is among these. The body of this cercaria is very slightly larger, but the proportions are similar. As in *C. ameriannae*, the caeca are distended posterior to the ventral sucker. The spination on both is similar. The genital primordium of each is wedge-shaped. The excretory systems differ in one point, for, though there are fourteen flame-cells in the body and four in the tail in each, the formula for *C. chrysenterica* is $2[(2+1)+(2+2+(2))]=18$, instead of $2[(2+2)+(2+1+(2))]=18$ as in *C. ameriannae*. Other differences are in the caudal bodies: *C. ameriannae* has none, whereas *C. chrysenterica* has several small irregular ones; and in the gland-cells which, though ventral to the caeca, four in number, and of similar size to those in *C. ameriannae*, are post-acetabular in position. They are, however, arranged in a grouping rather similar to that of the gland-cells in our cercaria. The second intermediate host of *C. chrysenterica* is unknown.

C. sudanensis No. 5 (Archibald and Marshall), from *Bulinus*, may be even more closely allied to *C. ameriannae*. It is unfortunate that its excretory system has not been described, for in all other respects, and most particularly with regard to the shape of the caeca, it resembles *C. ameriannae* very strongly, as far as can be determined from the description and figure. The major difference is that the two median gland-cells are situated slightly anterior to the two lateral cells. This arrangement is seen again in *C. letifera* (Fuhrmann), from *Limnaea;* but in this cercaria, the caeca are shorter and dilate less abruptly than in *C. ameriannae*, there is one fewer flame-cell on each side (the formula is $2[(2+2)+(2+(2))]=16$), and there are well-developed caudal bodies. *C. tenuis* Miller has four pre-acetabular gland cells with the same arrangement, but the caeca are shorter and are not dilated, and the flame-cell formula is $2[(2)+(2+1+(2))]=14$.

C. Diplostomi-spathacei (Rudolphi) (= *C. helvetica XXXI* Dubois), *C. Diplostomi-flexicaudi* Cort and Brooks, and *C. Diplostomi-murrayensis* Johnston and Cleland, all from species of *Limnaea*, are related to *C. ameriannae*. The important differences in these cercariae are firstly, that in all three the glands,

though ventral to the caeca and exhibiting a tendency to be arranged as in *C. amerianna*e are posterior to the ventral sucker; secondly, that there is one fewer flame-cell on each posterior collecting tubule, the formula being either $2[(2+1)+(2+1+(2))]=16$, or $2[(2+1)+(1+2+(2))]=16$; and thirdly, that caudal bodies are present in the tail-stem. In none do the caeca suddenly distend.

C. yogena Cort and Brackett, from *Stagnicola*, is very similar structurally to the last three, though slightly smaller; like them it has four gland-cells behind the ventral sucker, caudal bodies, and the same excretory formula. *C. maritzburgensis* Porter from *Limnaea*, is another form closely related to *C. yogena*, possessing the same excretory formula, and differing mainly in certain details of spination and proportions of the tail.

C. micradena Cort and Brackett (from *Stagnicola*), the larva of *Diplostomum micradenum*, with its metacercaria in tadpoles, and *C. tetradena* Johnston and Beckwith (1945), from *Plotiopsis*, are both smaller than *C. ameriannae*, but resemble it closely in a number of points; they differ in the shape of the caeca, the arrangement of the gland-cells, and in the possession of one more flame-cell on each posterior tubule. In *C. micradena* also the gland-cells are very small. *C. macradena* Cort and Brackett, from *Stagnicola*, which has the same excretory formula as *C. micradena*, is of a size similar to that of *C. amerianna*e, but the spines are nowhere arranged in definite transverse rows, the gland-cells are much larger than those of *C. amerianna*e and are situated differently, and the four flame-cells in the tail are situated close to the junction of tail and body.

C. longifurca Cort and Brooks, from *Limnaea*, and *C. marcianae* Cort and Brooks, from *Planorbis*, each with two small pairs of gland-cells, differ markedly in spination, size (both are much smaller than *C. amerianna*e), shape of the caeca, and proportions of the tail, and in the possession of either one (*C. longifurca*) or three (*C. marcianae*) more flame-cells on each side.

Cercaria Alariae-mustelae Bosma, from *Planorbula*, has two pairs of gland-cells, latero-posterior to the acetabulum; but the cercaria is so very much smaller, and differs in so many other respects from *C. amerianna*e that no close relationship seems possible. *Cercaria F* Harper, closely resembling the above, is also debarred from near relationship with *C. amerianna*e. The cercaria of *Strigea tarda* Steenstrup has four pre-acetabular gland-cells, but the excretory formula is $2[(1+1+1)+(2+(2))]=14$, and it is said to develop into a tetracotyle within the primary host, *Limnaea*.

Hence, it is clear that while the systematic position of *C. amerianna*e cannot be fully established, its affinities are with the Diplostomes. Some Diplostomes in which the fore and hind-body are scarcely differentiated externally have been

assigned to *Tylodelphys* whose type is *T. clavatum* (Nordm.). The larva of the latter is also known as *T. rachidis.* Another species is *T. excavata* (Rud.), recorded from Ciconiidae and rarely from Ardeidae and Podicipididae, the metacercaria being *T. rachiaeum* which occurs in the vertebral canal of frogs, *Rana* spp., in Europe, while the cercaria occurs in *Planorbis.* In the cercaria of *T. excavata* the four gland-cells are arranged in front of the ventral sucker, as in *C. ameriannae.* In the later stages pseudosuckers are present but are weakly developed. The structures have not been recognized in our metacercaria. In another *Tylodelphys, T. clavata,* from *Ardea* and *Circus,* the metacercaria occurs in the vitreous humour of the eye of European freshwater fishes.

SUMMARY.

Furcocercaria lessoni, a new species of Strigeid larva from *Limnaea* and *Planorbis,* from the River Murray, is a pharyngeal, distome, longifurcate cercaria, with four pairs of glands and two excretory commissures. The metacercaria is a Tetracotyle encysting in freshwater leeches, and the adult is probably a species of *Apatemon.*

C. ameriannae, a distome, longifurcate, pharyngeal cercaria from *Amerianna pectorosa,* is characterized by the possession of four pre-acetabular gland-cells and of an excretory system comprising 18 flame-cells and lacking commissures. The cercaria penetrates tadpoles and develops into an encysted metacercaria of the *Diplostomulum* type. The adult is probably Diplostome.

ADDENDUM.

Since this paper went to press, one by Olivier (*Tr. Amer. Micr. Soc.*, 61, 1942, 168–179) has come to our notice. In it is described *C. elodes* which resembles *C. ameriannae* more closely than does any other known to us, the only significant difference being that the four penetration gland-cells lie posterior to the ventral sucker in *C. elodes,* and the anterior to that organ in *C. ameriannae.* In both species the metacercaria develops in the notochord of tadpoles into a diplostomulum. It seems certain, therefore, that the two larvae are very closely related and may represent young stages of two different species of the same genus.

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UNDESCRIBED SPECIES OF CRANE-FLIES FROM NEW GUINEA IN THE SOUTH AUSTRALIAN MUSEUM (DIPTERA; TIPULIDAE)

By Dr. Charles P. Alexander, University of Massachusetts, Amherst, Massachusetts

Summary

I am much indebted to the Director and Trustees of the South Australian Museum for the opportunity to study a collection of Tipulidae made in the Torricelli Mountains in North-east New Guinea. This small but interesting series of flies has added several new species to those known from the island, the types being preserved in the South Australian Museum. The collection was made by the distinguished collector and explorer, Miss Lucy Evelyn Cheesman, whose paper, "The Border Mountains and Torricelli Range of Northern New Guinea," Geographical Journal, 1941, p. 170, ff, should be consulted.

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By DR. CHARLES P. ALEXANDER, UNIVERSITY OF MASSACHUSETTS, AMHERST, MASSACHUSETTS.

I AM much indebted to the Director and Trustees of the South Australian Museum for the opportunity to study a collection of Tipulidae made in the Torricelli Mountains in North-east New Guinea. This small but interesting series of flies has added several new species to those known from the island, the types being preserved in the South Australian Museum. The collection was made by the distinguished collector and explorer, Miss Lucy Evelyn Cheesman, whose paper, "The Border Mountains and Torricelli Range of Northern New Guinea," *Geographical Journal,* 1941, p. 170, ff, should be consulted.

Subfamily TIPULINAE.

PTILOGYNA Westwood, 1835.

PTILOGYNA CHEESMANÆ sp. nov.

General coloration of mesonotum and pleura dark brown, the postnotum more yellowed; antennae (female) with seven simply branched segments, the longest branch approximately one-half the length of the segment; wings light brown, the costal border darker; vague yellow areas beyond arculus, over origin of *Rs,* along the cord and in the base of cell R_2; vein R_1, entering R_{2+3} some distance before the fork of the latter, so vein R_{1+2+3} is subequal to vein R_1; veins R_{4+5} and M_{1+2} extensively fused.

♀ Length, about 13 mm.; wing, 12·3 mm.; antenna, about 2 mm.

Frontal prolongation of head dark fulvous brown; nasus lacking; palpi black. Antennae (female) 13-segmented, short; proximal four or five segments obscure yellow, the succeeding segments and all branches black; flagellar segments two to eight, inclusive, with a single short branch, longest on segments three to five, on outer segments becoming progressively shorter, that of segment eight a mere tubercle; longest branch approximately one-half the segment or a trifle more; outer three segments simple, nine and ten relatively short, subequal, the terminal one nearly twice as long, slender. Head above dark fulvous, somewhat darker on central portion; anterior vertex between eyes high and compressed.

Pronotum brown. Mesonotal praescutum largely destroyed by insect pests, the posterior third dark brown, somewhat more pollinose on the interspaces but not distinctly striped; scutum and scutellum dark brown or brownish black; mediotergite paling to obscure yellow, pleurotergite with the anapleurotergite brown, the katapleurotergite paler. Pleura chiefly dark brown, including the dorsopleural membrane. Halteres uniformly dark brown. Legs with the coxae and trochanters brown; femora brown, restrictedly yellow at base; the apex somewhat more intensely blackened; tibiae and trasi brown to dark brown. Wings with the ground colour light brown, very vaguely patterned with obscure yellow markings, especially near the wing base beyond the arculus; at origin of *Rs*; along cord extending from vein *R* virtually to the posterior border at Cu_1, more distinct over the anterior cord; a small spot in base of cell R_2; prearcular field and cells *C* and *Sc* to the region of the stigma darker brown, the colour thence continued as a slightly paler darkening to the wing tip; veins brown, not brightened in the yellowed areas. Venation: Sc_1 atrophied; Sc_2 entering *R* just beyond one-third the length of R_{2+3}; *Rs* very long, about two and one-half times R_{2+3}; free tip of Sc_2 distinctly preserved but pale; R_1 entering R_{2+3} some distance before fork, so R_1 is subequal in length to R_{1+2+3}; inner end of cell R_2 pointed; R_{4+5} extensively fused with M_{1+2}, as in the genus, the fusion subequal to the basal section of M_{1+2}, the second section of the latter a little shorter; *m* from two to four times the basal section of vein M_2 and a little shorter than the basal section of M_3; *m–cu* on M_4 shortly beyond origin; vein *2nd A* straight.

First abdominal tergite brownish black; tergites two to four, inclusive, brownish fulvous, the posterior margin broadly, the lateral borders more narrowly blackened; outer tergites more uniformly darkened; first sternite dark brown, the second fulvous; succeeding sternites more brownish fulvous, with dark margins; outer sternites more uniformly blackened. Ovipositor with the valves elongate, nearly straight, yellowish horn colour.

Holotype, ♀, Torricelli Mountains, altitude 200–1,000 feet, January, 1939 (Cheesman).

I take unusual pleasure in naming this fly for the collector, Miss Lucy Evelyn Cheesman, who has added so materially to our knowledge of the insect fauna of many of the Pacific Islands. The present fly is quite distinct from the two species hitherto made known, including the genotype, *Ptilogyna ramicornis* (Walker), widespread and common in eastern Australia, and the smaller *P. minima* Alexander, still known only from Melville Island, off the coast of Arnhem Land in the Northern Territory of Australia. The new insect differs conspicuously from the genotype in coloration and in the structure of the antennae, the flagellar segments bearing a single short branch in the female sex instead of

two unequal branches as in *ramicornis.* I have no information on the antennae of the female sex of *P. minima* which differs in all respects of coloration from the present fly.

Undoubtedly the antennae of the male of this new species will be found to conform to the striking flabellate type found in *Ptilogyna* Westwood and *Phacelodocera* Enderlein, which will probably have to be considered as representing subgenera, with *Ptilogyna* the oldest name. In conjunction with the fact that the antennae of the female of this new species are simply pectinate whereas in *ramicornis* they are bipectinate, it may be stated that such a difference is undoubtedly of specific value only. In allied groups, such as *Plusiomyia* Skuse, of Australia and New Caledonia, and *Ozodicera* Macquart, of tropical America, the degree of branching of the antennae in both sexes varies within surprisingly wide limits and the structure of this organ cannot be used safely in the definition of generic or subgeneric groups.

The present record is the first for any of the primitive Tipulinae having branched antennae in the Papuan Subregion. Attention should be called to the recent discovery of two striking new species of *Phacelodocera* in the island of New Caledonia.

CTENACROSCELIS Enderlein, 1912.

CTENACROSCELIS PERCONTRACTUS sp. nov.

Size relatively small (wing about 25 mm.); disk of praescutum with four brownish grey stripes, the lateral borders and interspaces dark brown; flagellar segments with the lower face slightly produced; verticle tubercle low, with a dark brown spot; femora yellow, the tips blackened; wings brownish yellow, restrictedly patterned with darker; cell R_3 strongly constricted before midlength.

♂ Wing, 24·5 mm.; antenna, about 3·2 mm.

♀ Length, about 29 mm.; wing, 26·5 mm.

Frontal prolongation of head cinnamon brown above, somewhat darker on sides; nasus long and conspicuous; palpi brown, the incisures restrictedly pale; terminal segment short, black. Antennae with scape brownish yellow, pedicel yellow, flagellum brown; flagellar segments with the lower face slightly produced, somewhat more so in the type. Head above light brown behind, more brownish yellow in front, the low vertical tubercle with a dark brown spot; anterior vertex nearly three times as wide as the diameter of scape.

Pronotum brown above, paler on sides. Mesonotum discoloured, its pattern describable in general terms only; disk of praescutum with four brownish grey stripes, the lateral pair clearer grey; borders of all stripes and the interspaces

darker brown; humeral region of praescutum restrictedly yellow; each scutal lobe with two grey areas, the remainder dark brown; scutellum brownish grey, with a central brown line; mediotergite buffy grey; the narrow posterior border and a capillary median line darker. Pleura with the dorsopleural region buffy yellow, below which is a brown longitudinal stripe extending from the cervical region backward, becoming obsolete at the pteropleurite; ventral pleurites grey (type) or more yellowed (allotype), the sternopleurite patterned with darker, especially in the type. Halteres dark brown, the base of stem narrowly yellow. Legs with the coxae yellowish grey, patterned with brown, very distinctly so in the type, nearly obsolete in the allotype; femora yellow, the tips broadly blackened; tibiae and tarsi yellow, the latter darker at tips. Wings relatively narrow, the ground colour brownish yellow, restrictedly patterned with darker, including cells *C* and *Sc* and the outer radial field in cells Sc_2, R_2 and R_3; stigma and a conspicuous seam over *m–cu* and distal section of vein *Cu* darker brown; obliterative streak on anterior cord restricted in area; veins brown, more yellowed in the obliterative field. Venation: Cell R_3 strongly constricted before midlength, at the narrowest point a little more than one-third as wide as it is across the sibbasal portion; *m–cu* at near one-third the length of M_{3+4}.

Abdominal tergites dark reddish brown, with indications of still darker brown median and sublateral stripes, the lateral borders narrowly dark brown; sternites dark brownish grey.

Holotype, ♀, Torricelli Mountains, altitude 200–1,000 feet, January, 1939 (Cheesman). Allotopotype, a broken ♂.

Superficially the present fly is most like *Ctenacroscelis umbrinus* (Wiedeman), differing conspicuously in the structure of the antennae, details of coloration, and the unusually constricted cell R_3 of the wings.

CTENACROSCELIS ILLEX sp. nov.

Size large (wing, male, 36 mm.); mesonotal praescutum with three dark grey stripes that are bordered by brown; pleura yellow, variegated by brown areas; femora brownish yellow, the tips dark brown, preceded by a clearer yellow ring; wings long and narrow, restrictedly patterned with brown; male hypopygium with the tergal lobes short, nearly truncate, the median area with a broad furrow; inner dististyle long and slender, the outer half a long blade that terminates in a decurved beak.

♂ Length, about 28 mm.; wing, 36 mm.; antenna, about 3·9 mm.

Frontal prolongation of head a little shorter than the remainder, light brown; nasus elongate; basal three palpal segments brown, paler at the incisures, the terminal segment dark brown. Antennae with the flagellar segments almost cylindrical, not or scarcely produced. Head above dark fulvous brown, still

darker medially; vertical tubercle low, with two impressed longitudinal lines that divide the tubercle into three parts.

Pronotum brown. Mesonotal praescutum with three dark grey stripes that are more or less distinctly bordered by brown, the intermediate pair barely divided by a narrow darker grey area; posterior interspaces buffy grey, the lateral borders and anterior interspaces broadly dark brown; suture pale yellow, especially on the scutal side; each scutal lobe with two dark grey areas that are vaguely bordered by brown, the posterior portion of scutum infuscated; scutellum and mediotergite very pale yellow, the latter more pruinose on posterior half, the caudal border dark brown, with indications of a capillary brown median vitta extending cephalad almost to the anterior border; pleurotergite light grey. Pleura light yellow or yellowish grey, variegated by brown areas, especially large and distinct on the propleura, dorsal anepisternum and ventral sternopleurite; dorsopleural membrane yellow, its borders and especially the anterior end more infuscated. Halteres with stem infuscated, its base yellowed, the knob vaguely brightened. Legs with the coxae yellowish grey, the fore pair more patterned with brown; trochanters yellow; femora brownish yellow, the tips conspicuously dark brown, preceded by a slightly narrower clearer yellow ring; tibiae and tarsi orange; claws with a low obtuse knob shortly before midlength. Wings long and relatively narrow, with a strong brown tinge, restrictedly patterned with darker brown, especially in the prearcular field, at arculus, along posterior cord, in stigmal region, and at end of vein *2nd A*; narrower and less conspicuous seams over outer end of cell *1st* M_2 and adjoining veins; veins brown. Venation: *Rs* about equal in length to second section of vein M_{1+2}; *m–cu* at midlength of vein M_{3+4}; petiole of cell M_1 about two-thirds *m*.

Abdomen with tergites dark reddish brown, with a darker brown sublateral stripe; lateral borders narrowly grey; posterior margins of segments very narrowly darkened; narrow basal rings more glabrous and shiny; basal sternites yellow, the intermediate ones chiefly concealed; subterminal segments extensively more darkened; hypopygium variegated brown and obscure yellow. Male hypopygium with the lateral lobes short, nearly truncate, the broad median area depressed and not provided with the abundant short setae that cover most of the remainder of tergite. Outer dististyle broadly flattened, truncated at apex, the entire surface with very abundant delicate setulae but with very few scattered pale setae. Inner dististyle long and slender, the basal third more dilated and provided with setae, those of the lower expanded portion longer and more conspicuous; at near midlength the style is constricted, thence dilated into a blade that narrows gradually to the slightly decurved beak.

Holotype, ♂, Torricelli Mountains, altitude 200–1,000 feet, January, 1939 (Cheesman).

The most similar species is *Ctenacroscelis conspicabilis* (Skuse) which differs in the coloration and in the structure of the antennae and male hypopygium.

TIPULA Linnaeus, 1758.

TIPULA (PAPUATIPULA) OBEDIENS sp. nov.

General coloration of mesonotal praescutum buffy grey with four clearer grey stripes that are narrowly bordered by brown; antennae short, flagellar segments conspicuously bicoloured, yellow, with darkened bases; femora brownish yellow, the tips more infuscated; wings brownish grey, cells *C* and *Sc* light brown, the stigma darker brown; *m–cu* close to midlength of M_{3+4}; male hypopygium with the outer dististyle narrowed outwardly, tipped with several spines, with a larger spinous point on ventral surface back from apex.

♂ Length, about 16–17 mm.; wing, 15–16·3 mm.; antenna, about 3–3·1 mm.

♀ Length, about 21–22 mm.; wing, 16–17 mm.

Frontal prolongation of head light brown or brownish yellow; nasus distinct; palpi with the first segment light brown, the remainder dark brown, the incisures pale; terminal segment more reddened apically. Antennae short; basal three segments yellow, the remainder bicoloured, dark brown basally, the outer portion yellow, the amount of the latter colour becoming less on the outer segments; verticils long and conspicuous; basal swellings scarcely developed. Head above buffy, patterned with brown on the posterior vertex, including a central marking and more extensive postocular areas; vertical tubercle low and simple.

Pronotum light brown, narrowly darkened medially and more extensively on sides. Mesonotal praescutum buffy grey, with four clearer grey stripes that are narrowly bordered by brown, the lateral pair more extensively suffused; posterior sclerites of notum yellow, the scutal lobes patterned with brownish grey areas that are more or less bordered by brown. Pleura light grey, patterned with darker, most conspicuously so on the ventral sternopleurite. Halteres with stem yellowish brown, clear basally, the knobs more darkened. Legs with the coxae brownish grey; trochanters whitish yellow; femora brownish yellow, the tips more infuscated; remainder of legs light brown; claws (male) elongate, bidentate, with two teeth, basal and medial in position. Wings brownish grey, cells *C* and *Sc* light brown; stigma long and narrow, darker brown; a very narrow dark marginal seaming in outer radial field; anterior cord narrowly bordered by brown; veins brown. Venation: R_{1+2} entirely atrophied; vein R_3 straight, in alignment with R_{2+3}, the latter nearly twice *Rs*; *m–cu* close to midlength of M_{3+4}, about as long as *Rs*; cell *2nd A* relatively wide.

Basal abdominal tergite grey; remainder of abdomen chiefly brown or reddish brown; the sternites somewhat paler, especially in male. Male hypopygium with the tergite produced into two blackened lobes, the surface with microscopic

blackened spines. Outer dististyle a long lobe, narrowed to the apex that bears several spinous points, one lower surface before apex with a stronger spine. Inner dististyle with the main body a flattened blade, narrowed to the obtuse beak, the subapical beak darkened and similarly obtuse; at base of inner dististyle with a flattened lobe that narrows to a slightly curved blackened point, the surface back from tip with dense erect setulae. Aedeagus blackened, conspicuous. Ovipositor with cerci slender, straight or with the tips slightly decurved.

Holotype, ♂, Torricelli Mountains, altitude 200–1,000 feet, January, 1939 (Cheesman). Allotopotype, ♀. Paratopotypes, 1 ♂, 2 ♀♀.

This fly is most similar to *Tipula* (*Papuatipula*) *divergens* de Meijere and *T.* (*P.*) *meijereana* Alexander (*dentata* de Meijere, preoccupied), both of southwestern New Guinea. It differs in the details of coloration of the thorax and appendages and in the structure of the male hypopygium, especially the styli.

TIPULA (PAPUATIPULA) SURCULARIA sp. nov.

Antennae with flagellar segments bicoloured, brownish black basally, the stems yellow; wings greyish yellow, the prearcular and costal fields strongly yellowish fulvous; outer dististyle relatively narrow, terminating in a blackened point; at base of inner style with a short, stout blackened lobe.

♂ Length, about 15 mm.; wing, 17 mm.; antenna, about 3 mm.

Frontal prolongation of head relatively long, somewhat shorter than the remainder, yellow above, the sides and the nasus a little darker; palpi with the basal segments brownish yellow, the third one darker, terminal segment chiefly black. Antennae with basal three segments yellow, succeeding segments bicoloured, their basal portions brownish black, the remainder yellow, the amount of dark increasing slightly on the outer segments but the bicolourous nature persisting to the reduced terminal segment; basal enlargements poorly indicated; longest verticils a little less than the segments. Head brownish grey, paler in front, with a narrow brown vitta extending from between the antennal bases to the occiput; vertical tubercle low.

Pronotum pale yellow. Mesonotal praescutum and scutum concealed in mounting; scutellum and postnotum greyish testaceous. Pleura and pleurotergite more whitened, without pattern. Halteres elongate, stem pale brown, knob a little more darkened. Legs with the coxae whitened; trochanters pale yellow; all legs detached and glued to the specimen; basal portions almost uniformly brownish yellow, the tarsal segments somewhat darker. Wings greyish yellow, the prearcular and costal fields even more yellowed. Venation: *Rs* short, about two-thirds *m–cu*; R_{1+2} entirely atrophied; R_3 longer than R_{2+3}; inner end of cell *1st* M_2 pointed; *m–cu* at near two-thirds the length of M_{3+4}; petiole of cell M_1 longer than *m*; cell *2nd A* relatively narrow.

Basal abdominal tergites testaceous brown, darker laterally, on the fourth and succeeding segments becoming darker brown, the posterior borders narrowly pale; basal sternites more uniformly yellow, with paler posterior borders; subterminal three segments more uniformly dark brown, with pale borders; hypopygium chiefly yellow. Male hypopygium with the caudal margin of the ninth tergite having a relatively narrow U-shaped notch, the lateral lobes densely margined with microscopic blackened spiculose points, those immediately back of this border sparse but larger and stronger, merging behind with the more normal setae. Outer dististyle relatively narrow, arcuated, terminating in a short blackened spinous point. Inner dististyle with the beak relatively stout, very slightly decurved, the lower beak more blackened, the margin microscopically crenulated; at base of style with a short stout blackened lobe that extends laterad into an acute point.

Holotype, ♂, Torricelli Mountains, altitude 200-1,000 feet, January, 1939 (Cheesman).

This fly differs from *Tipula* (*Papuatipula*) *divergens* de Meijere and *T.* (*P.*) *meijereana* Alexander, especially in the structure of the male hypopygium.

Tipula (Indotipula) serritergata sp. nov.

Allied to *vilis*; general coloration of praescutum obscure orange, the four olive-yellow stripes barely distinguishable; flagellar segments binodose; wings yellowish, the cells beyond cord more infuscated, cell *Sc* brown; cell *2nd A* very narrow; male hypopygium with the upper margin of the tergal blades microscopically toothed; outer dististyle weakly bilobed; inner dististyle with the outer basal lobe stout, at apex with a shallow emargination to appear bilobulate.

♂ Length, about 15 mm.; wing, 17 mm.; antenna, about 3·3 mm.

♀ Length, about 18 mm.; wing, 17 mm.

Frontal prolongation of head brownish yellow; nasus very long and slender; palpi brownish yellow, the terminal segment passing into brown. Antennae with the scape and pedicel obscure yellow; flagellum black; flagellar segments strongly binodose, as common in various species of the group, the outer enlargement becoming more triangular and conspicuous on the outer segments; verticils very long. Head above brownish grey, paler behind; a capillary more blackish median stripe; posterior orbits beneath light grey.

Pronotum brown. Mesonotal praescutum with the ground obscure orange or brownish orange, the four stripes barely distinguishable against the ground, slightly more olive yellow; setae of the praescutal interspaces very delicate, pale; scutum olive-yellow; posterior sclerites of notum more orange yellow, the parascutella and pleurotergite more infuscated; scutellum with very vague indications of a paler central line. Pleura chiefly yellow, the propleura and anepisternum

restrictedly patterned with daker. Halteres dark brown, the base of stem restrictedly yellow. Legs with the coxae testaceous brown; trochanters yellow; femora yellowish brown, the tips very gradually passing into darker; tibiae light brown; tarsi brownish black; last tarsal segment at base of lower surface with a pencil of setae; claws (male) bidentate; spur-formula 0—0—1. Wings with a yellowish ground, more infuscated beyond cord; prearcular field and cell *C* more yellowed, cell *Sc* infuscated; stigma and adjoining cells more strongly darkened; veins brown. Venation: *Rs* and *m–cu* subequal; R_{1+2} strongly preserved, cell R_2 small; petiole of cell M_1 shorter than *m*; cell *1st* M_2 narrow, pentagonal, the proximal end produced basad; cell *2nd A* very narrow.

Basal abdominal tergites reddish brown, on about the third and succeeding segments dark brown, the caudal margins vaguely brightened; sternites orange-yellow, the outermost segments and hypopygium more infuscated. Ovipositor with cerci long and slender, very slightly decurved, the narrowly obtuse tips pale. Male hypopygium with the tergite and sternite fused, the basistyle completely cut off by a suture. Region of tergite produced into two blackened blades or lobes; viewed from above, these separated by a broad U-shaped or quadrate notch, the surface of mesal face with a fringe of coarse reddish setae; viewed from the side the blades appear much deeper, the inner margin microscopically toothed, the ventral outer angle produced into a sharp tooth, the ventral cephalic portion a rounded lobe or knob. Region of ninth sternite produced ventrad into a small fingerlike lobe. Outer dististyle conspicuously expanded outwardly, unequally bilobed at apex, the shorter inner lobe with stouter and more dense black setae. Inner dististyle with the beak relatively slender, the lower beak a rounded black knob; outer basal lobe a stout pale lobe that is shallowly emarginate at tip to form two bluntly obtuse lobes. Gonapophyses appearing as very broadly flattened plates, the tips obtuse, subtending the very slender aedeagus; the latter, just before apex on either side, produced into a small point to produce a crosslike appearance.

Holotype, ♂, Torricelli Mountains, altitude 200–1,000 feet, January, 1939 (Cheesman). Allotopotype, ♀.

Tipula (Indotipula) serritergata is allied to various other Oriental species of the subgenus that centre about *T. (I.) vilis* Walker, differing most evidently in the structure of the male hypopygium, particularly the tergite and inner dististyle.

SCAMBONEURA Osten Sacken, 1882.

SCAMBONEURA NIGRODORSALIS sp. nov.

Mesonotum polished black, the postnotum chiefly yellow; pleura yellow; antennae (male) elongate; head yellow, posterior vertex with a delicate reddish brown vitta; wings whitish hyaline, cell *Sc* pale brown; stigma dark brown;

anterior cord strongly bowed; basal abdominal tergites patterned with yellow, blue-black and opaque black; outer abdominal segments dull orange to chestnut brown.

♂ Length, about 12·5–13 mm.; wing, 12–12·5 mm.; antenna, about 6·5 mm.

♀ Length, about 15–16 mm.; wing, 13 mm.

Frontal prolongation of head clear light yellow; nasus yellow, the tip darkened, with long black setae; palpi yellow, the outer third or fourth of the terminal segment infuscated. Antennae (male) elongate, as shown by the measurements; scape dark brown, pedicel obscure brownish yellow; flagellum black, the apices of the more proximal segments more or less brightened, in cases rather distinctly so; flagellar segments elongate-subcylindrical, the basal enlargements very small; verticils less than one-third the length of the segments. Head light yellow; posterior vertex with a delicate reddish brown vitta, narrowed to a point on the low vertical tubercle, becoming more diffuse behind; no occipital brand.

Pronotum infuscated, the scutum very narrowly more brightened behind. Mesonotal praescutum and scutum almost uniformly shiny black, with vague bluish reflections; scutellum somewhat more brownish black or dark brown; median region of scutum vaguely brightened; mediotergite clear light yellow, restrictedly darkened behind; pleurotergite very light yellow, the posterior portion weakly infuscated. Pleura light yellow, the dorsal anepisternum and posterior portion of dorsopleural membrane vaguely more infuscated. Halteres brownish black, the extreme base of stem brightened. Legs with the coxae and trochanters light yellow, the fore coxae, in cases, a trifle more darkened; femora obscure brownish yellow, tibiae darker, tarsi passing into brownish black or black; claws (male) toothed and with sparse but very conspicuous setae. Wings whitish hyaline, cell *Sc* pale brown; stigma and adjacent region dark brown but very small and correspondingly inconspicuous; veins black, those in the prearcular field brown. Venation: Anterior cord very strongly bowed, in degree about as in *subfaceta*; veins at outer end of stigma very atrophied and crowded, with no trace of a basal spur of R_{1+2}; vein R_3 lying close to the margin, narrowing the cell; outer medial forks deep.

Abdominal tergites handsomely patterned; basal segment blackened, obscure yellow on sides; second segment orange on basal half, polished blue-black on posterior ring, the posterior portion of both the yellow and blackened portions narrowly bordered by opaque velvety black, on the former microscopically impressed; on tergites three to five the pattern is similar, with the amount of yellow becoming reduced; lateral borders of tergite five, as well as segments six to eight, light chestnut brown to dull orange, the base of tergite six extensively blackened; sternites and hypopygium light chestnut brown to dull orange. Male

hypopygium with the posterior border of tergite convexly rounded, on either side of the midline below the border with a flattened lobe; on ventral margin back from this lobe with a coarsely toothed blackened plate and a few microscopic blackened peglike or conical setae. Outer dististyle broad basally, narrowed at apex into a slender lobe. Inner dististyle with the beak and outer portion heavily blackened, the former slender. Apex of gonapophysis much expanded into a triangular blade. Appendage of ninth sternite a subquadrate setiferous cushion.

Holotype, ♂, Torricelli Mountains, altitude 200–1,000 feet, January, 1939 (Cheesman). Allotopotype, ♀. Paratopotypes, 6 ♂♂.

Although the genus *Scamboneura* had been recorded from New Guinea, no species had been described. The present fly is very different from the other Australasian species, especially in venation, being closest to *Scamboneura subfaceta* Alexander, of northern Celebes, but differing in all details of coloration.

Subfamily LIMONIINAE.

Tribe Lechriini.

LECHRIA Skuse, 1890.

LECHRIA ALBIDIPES sp. nov.

Size large (wing, female, over 10 mm.); general coloration of mesonotum yellow, variegated with black, most intensely so on the cephalic portion of the praescutum; thoracic pleura yellow, striped longitudinally with black; femora dark brown, tibiae and tarsi whitened; wings yellowed, the costal border narrowly dark brown; wing margin and veins narrowly bordered by paler brown; cell *1st* M_2 very long and narrow, with *m–cu* just beyond midlength; basal sections of veins M_{1+2} and M_{3+4} longer than the stem of vein M.

♀ Length, about 9 mm.; wing, 10·3 mm

Rostrum dark brown; palpi black. Antennae with the scape yellow, pedicel and flagellum black; flagellar segments cylindrical, the extreme incisures pale; verticils shorter than the segments. Head uniformly dark coloured.

Pronotum blackened in front, the posterior portion abrupt light yellow. Mesonotum yellow, the cephalic third of the praescutum intensely and conspicuously blackened, the colour continued laterad as a narrow line over the humeri and on to the dorsopleural region; scutal lobes less intensely darkened; mediotergite chiefly blackened, the sides and a capillary median line more yellowed; pleurotergite more extensively yellow. Pleura yellow, conspicuously variegated with brownish black, including a spot below the wing root; a narrow stripe

extending from the cervical region backward across the ventral anepisternum and dorsal sternopleurite; a broader stripe on ventral sternopleurite. Halteres yellow, knob slightly darkened, the tip obscure yellow. Legs with the coxae and trochanters obscure yellow; femora uniformly dark brown; tibiae abruptly whitened, a little more obscured beyond the base; basal three tarsal segments similarly whitened, the terminal two segments abruptly blackened. Wings with the ground colour yellow, the costal border narrowly dark brown, involving cells *C* and *Sc*, with the elongate stigma, the latter restricted to cell *C*; wing margin and most of the veins narrowly bordered by paler brown, scarcely affecting the general pattern; prearcular field yellow; veins dark brown. Venation: *r–m* nearly its own length before the fork of *Rs*; cell *1st* M_2 of unusual length, subequal to vein M_3 beyond it; basal sections of veins M_{1+2} and M_{3+4} almost equal in length of the latter slightly shorter, both longer than the stem of vein *M*; *m–cu* about opposite *r–m*, placed just beyond midlength of cell *1st* M_2; basal section of M_{3+4} a little longer than the second section; *m* longer than the basal section of vein M_3; vein *2nd A* straight, the cell relatively narrow; anterior arculus lacking; posterior arculus joining *M* at a right angle.

Abdominal tergites dark brown, the lateral portions yellow; sternites yellow, variegated laterally and posteriorly with dark brown. Ovipositor with the valves horn-yellow, darker basally; cerci slender, very gently upcurved.

Holotype, ♀, Torricelli Mountains, altitude 200–1,000 feet, January, 1939 (Cheesman).

Lechria albidipes is readily told from all other described species by the large size, pattern of the body, legs and wings, and especially by the venation, as the unusually long cell *1st* M_2. Among such species it is possibly nearest *L. leucopeza* de Meijere, of Java, but the resemblance is not close. This is the first record of either the genus or tribe in New Guinea.

Tribe Limoniini

LIMONIA Meigen, 1803.

LIMONIA (LIBNOTES) ELISSA sp. nov.

Allied to *eboracensis*; mesonotal praescutum chiefly covered by three confluent dark brown stripes, the posterior sclerites of notum dark, more or less pruinose, especially the postnotum; head grey; legs brown; wings pale brownish yellow, conspicuously crossbanded with pale brown, including a broad complete band at cord; cell *1st* M_2 small, about as long as *Rs*; abdomen reddish brown; male hypopygium with the rostral spines four, blunt at tips.

♂ Length, about 9 mm.; wing, 10·5 mm.

Rostrum reddish brown, palpi black. Antennae with scape and pedicel black, the former sparsely pruinose; flagellum broken. Head grey, the posterior vertex a trifle infuscated; anterior vertex reduced to a narrow line.

Pronotum brown. Mesonotal praescutum chiefly covered by three confluent dark brown stripes, the humeral and lateral portions greyish pruinose; posterior sclerites of notum dark brown, more or less pruinose, especially the mediotergite; pleurotergite heavily pruinose. Propleura, basal half of fore coxae, and most of mesepisternum dark brown, the mesepimeron and metapleura in part pale. Halteres with stem brownish yellow, knobs broken. Legs with the coxae reddish brown, sparsely pruinose, the fore pair darker; trochanters obscure yellow; remainder of legs brown, the femoral bases restrictedly obscure yellow. Wings with the ground pale brownish yellow, conspicuously banded with pale brown, including a broad complete band at cord, its outer margin virtually straight, the inner margin slightly convex; wing-tip somewhat paler brown; basal cells even less evidently clouded; more distinct but smaller pale brown areas in cell *Sc* before the origin of *Rs*, at origin of *Rs*, and over R_2 and adjoining veins; veins yellow, darker in the patterned areas. Venation: Sc_1 ending nearly opposite fork of M_{1+2}, Sc_2 near its tip; *Rs* straight, oblique; free tip of Sc_2 and R_2 in transverse alignment; outer radial and medial veins all generally parallel to one another and all only moderately decurved; cell *1st* M_2 small, about as long as *Rs*; *m* and basal section of M_3 in virtual transverse alignment; *m–cu* beyond midlength of cell *1st* M_2 anal veins convergent at bases.

Abdomen reddish brown, the hypopygium somewhat more yellowed. Male hypopygium with the caudal margin of tergite virtually convex, with a small median notch. Paired setae of tubercle of ventral dististyle very long; rostral spines apparently four, blunt at tips.

Holotype, ♂, Torricelli Mountains, altitude 200–1,000 feet, January, 1939 (Cheesman).

The present fly is most similar to *Limonia* (*Libnotes*) *eboracensis* Alexander, of New Britain, differing especially in the body and wing coloration, and in the venation. By Edwards' key to the then known species of *Libnotes* (1928), the species runs, more or less, directly to *L.* (*L.*) *aurantiaca* (Doleschall) and allies, disagreeing in all details of coloration.

Subgenus DAPANOPTERA Osten Sacken, 1881.

Ten species of these striking crane-flies had previousy been characterized, all but one having been described from Dutch New Guinea, and from certain of the islands to the westward in Wallacea, including Mysol (Misool) and Buru (Boeroe). The single remaining species is the distinct *Limonia* (*Dapanoptera*)

richmondiana (Skuse), known from Queensland and northern New South Wales. No species had been recorded previously from New Guinea eastward of the longitude of Hollandia (Humboldt Bay), so the occurrence of four species in north-east New Guinea, as herewith recorded, is somewhat noteworthy.

Kertész and all later writers have credited the subgenus *Dapanoptera* to Westwood, 1881, but it is now evident that this is incorrect and that the group was first defined by Osten Sacken. It appears that about 1880 Westwood submitted a specimen of this subgenus to Osten Sacken for his opinion and the latter's notes and discussion for forthcoming definition of the new group were submitted to Westwood, who incorporated them in his 1881 paper, but clearly credited the subgenus to Osten Sacken. The latter's own first definition of *Dapanoptera* did not appear until 1887 (Berlin. Entomol. Zeitschr., 31: 179).

A KEY TO THE PAPUAN SPECIES OF DAPANOPTERA.

1. Wings brown at base and apex, with a complete yellow band at near midlength 2
   Wings without a central yellow band that completely crosses the disk .. 6

2. Wing apex broadly dark brown or black so the white stigmal spot is at near midlength of the darkening 3
   Wing apex more narrowly darkened so the white stigmal spot is at or close to its inner margin 4

3. Thorax grey, the praescutum before the suture with two dull black longitudinal stripes; halteres white; femora chiefly yellow, the tips darkened. (New Guinea Humboldt Bay, north-east New Guinea.)
   meijereane Alexander (*pulchra* de Meijere, preocc.)
   Thorax dark reddish brown to almost black; halteres with stem black, knob pale yellow; legs entirely black. (New Guinea: Humboldt Bay.)
   carolina Edwards

4. Abdomen with base and apex blackened, the intermediate segments yellow. (New Guinea: Manokwari.) .. .. *latifascia* (Walker)
   Abdomen black, without yellow pattern 5

5. Halteres entirely black; basal dark band of wing broad. (Mysol; New Guinea: Manokwari) .. .. *auroatra* (Walker)
   Halteres with whitened knobs; basal dark band of wing narrower (apical wing band slightly invading cell *1st* M_2; *m–cu* at midlength of cell *1st* M_2). (South-west New Guinea: Noord River.) .. *fascipennis* (de Meijere)

6. Wings with white spots additional to the sigmal one; supernumerary cross-vein far beyond the outer end of cell *1st* M_2, only about twice its length from the apical border 7
   Wings with only the white stigmal spot; supernumerary cross-vein close to the outer end of cell *1st* M_2, usually only about its own length beyond the cell 8

7. Posterior wing border conspicuously sinuous or emarginate; disk with several white spots. (New Guinea: Manokwari.) .. *plenipennis* (Walker)
Posterior wing border even and normal; a single white supplementary spot; this located at the supernumerary cross-vein. (New Guinea: South-west.) *versteegi* (de Meijere)

8. Thorax dull black, the pleura with a yellowish white spot beneath the halteres; abdomen black, segments two and three yellow; wings blackish brown, with several small darker spots; basal half of wing posteriorly, including cells *1st A*, *2nd A* and the outer portions of *M* and *Cu* with an extensive brownish yellow area that reaches vein *M* in front, bordered by a very irregular dusky line; halteres with brown stem and yellow knob. (Buru; New Guinea: Dutch New Guinea, north-eastward to the Torricelli Mountains.) .. .. .. *perdecora* (Walker) (*lorentzi* de Meijere)
Thorax reddish brown or reddish yellow, unpatterned; abdomen uniformly darkened 9

9. Thorax almost uniformly dark reddish brown, the abdomen dark brown or brownish black; stigmal white spot not bordered by brown; stem of halteres infuscated. (North-east New Guinea.) .. .. *torricelliana* sp. nov.
Thorax and abdomen dull reddish yellow to light yellow; stigmal white spot narrowly bordered by brown; stem of halteres pale, at least on basal half 10

10. Thorax and abdomen dull reddish yellow; wings opaque, dull whitish yellow, tinged with brown; stigmal white spot narrowly bordered by brown; vein *C* on apical half brown, posterior margin of wing with a weaker darkened border; halteres yellowish white. (South-west New Guinea: Noord River.) *candidata candidata* Alexander (*pallida* de Meijere, preocc.)
Thorax and abdomen light yellow; wings fulvous yellow, the outer half a little more infuscated; stigmal white spot encircled by dark brown; halteres with stem yellow, darkened outwardly, the knob again light yellow. (North-east New Guinea.) .. .. *candidata opulenta* subsp. nov.

LIMONIA (DAPANOPTERA) MEIJEREANA Alexander.

Torricelli Mountains, January, 1939 (Cheesman).

LIMONIA (DAPANOPTERA) PERDECORA (Walker).

Torricelli Mountains, January, 1939 (Cheesman).

LIMONIA (DAPANOPTERA) TORRICELLIANA sp. nov.

General coloration of thorax dark reddish brown; antennal scape and pedicel brown, basal flagellar segments obscure brownish yellow; anterior vertex (male) a little wider than the diameter of scape; halteres with stem infuscated; knob yellow; femora yellow, the tips more infuscated; wings with a strong yellowish brown suffusion, the base narrowly more blackened; cells *Cu* and the Anal cells somewhat clearer yellow than the remainder of ground; white stigmal spot not

margined with darker; no dark spots on wing; *Rs* about three times the basal section of R_{4+5}; vein *2nd A* almost evenly convex; abdomen brownish black.

♂ Length, about 7–8 mm.; wing, 10·5–12 mm.

Rostrum and palpi black. Antennae with scape and pedicel brown; basal flagellar segments obscure brownish yellow, the outer four or five a little more infuscated; basal segments oval, the outer ones subcylindrical; longest verticils unilaterally arranged, subequal in length to the segments. Head in front light silvery, behind brownish black with a more sparse grey pruinosity; central portion of posterior vertex with an elongate more blackish spot; anterior vertex (male) a little wider than the diameter of scape.

Thorax almost uniformly dark reddish brown, variegated with slightly more yellowed areas, including the pronotal scutellum, region of the suture, central portion of scutum behind and much of the scutellum; dorsopleural membrane brownish black. Halteres with stem infuscated, knob yellow. Legs with the coxae and trochanters concolourous with the pleura; femora yellow, becoming more infuscated on the outer third, most intensely so at the tips; tibiae and tarsi brown; claws (male) with a major outer spine and about four smaller teeth nearer base. Wings with a strong yellowish brown suffusion, the base, to just beyond the level of arculus, more blackened; just beyond this dark area in cells *cu, 1st A* and *2nd A* the membrane more yellowed, merging gradually with the ground, not demarked by clear-cut infuscations as in *perdecora*; white stigmal spot conspicuous, virtually obliterating the included veins, not margined with darker; no dark spots on wings; veins reddish brown, darker in the basal infuscated band; membrane adjoining the veins very narrowly and insensibly brightened. Venation: *Rs* arculated, about three times the basal section of R_{4+5}; cell *1st* M_2 elongate, a little longer than the distal section of vein M_3; supernumerary crossvein its own length beyond the fork of *M*; Anal veins gradually diverging, *2nd A* almost evenly convex.

Abdomen, including hypopygium, dark brown or brownish black, the posterior borders of the more proximal segments a little more reddened.

Holotype, ♂, Torricelli Mountains, altitude 200–1,000 feet, January, 1939 (Cheesman). Paratopotype, ♂, in poor condition; Alexander Collection.

I would regard this species as being most nearly allied to *Limonia* (*Dapanoptera*) *perdecora* (Walker), from which it differs conspicuously in the coloration of the body and wings. The latter are not completely crossbanded with yellow, as is the case in the various species that centre about *auroatra* (Walker).

LIMONIA (DAPANOPTERA) CANDITATA OPULENTA subsp. nov.

General coloration of thorax and abdomen light yellow, the praescutum and scutal lobes with slightly more fulvous yellow areas; antennae with the flagellar

segments brown, vaguely paler at their bases; anterior vertex reduced to a narrow strip; halteres yellow, the stem dark brown at outer end; femora yellow, the tips narrowly dark brown; wings with a strong fulvous yellow ground, the outer half a trifle more infuscated; a very restricted brown pattern, including a complete border to the white stigmal spot; *Rs* elongate, exceeding four times the basal section of R_{4+5}; cells *1st* M_2 longer than any of the veins beyond it; abdomen fulvous yellow, the hypopygium dark brown.

♂ Length, about 12 mm.; wing, 16·5 mm.

Rostrum and palpi black, the former a trifle longer than the scape. Antennae with scape brownish black; pedicel dark brown; flagellar segments brown, their bases narrowly and vaguely paler; segments cylindrical or nearly so, longer than the verticils; terminal segment strongly narrowed on apical third. Head dark grey, the occipital region restrictedly obscure yellow; eyes large, reducing the anterior vertex to a narrow strip, the latter a trifle elevated, the posterior vertex immediately behind with a narrow groove.

Pronotum dark orange in front, paling to yellow behind. Thorax almost uniformly light yellow, the four praescutal stripes and the areas on the scutal lobes a trifle more fulvous yellow, only slighty differentiated from the ground. Halteres relatively long, stem yellow, darkened outwardly, just before the light yellow knob becoming dark brown. Legs with the coxae and trochanters light yellow; femora brownish yellow, somewhat clearer yellow at base, the tips narrowly dark brown; tibiae and tarsi dark brown to brownish black; claws (male) with six or seven small denticles basad of the outer spine. Wings with a strong fulvous yellow ground, the outer half a little more infuscated than the yellow proximal portion; a very restricted darker brown pattern, including the prearcular field, a small postarcular area, and spots at origin of *Rs* and fork of *Sc*; white stigmal spot small but conspicuous, encircled by dark brown; wing margin from shortly before apex back to cell *2nd A* narrowly margined with brown, narrower and more intense near apex, more diffuse behind; no other darkenings on wing disk beyond the level of vein R_2, excepting very vague clouds over *m* and the supernumerary crossvein; veins yellow, inconspicuous against the ground, not darkened in the spots at *Rs* and *Sc*; in the whitened stigmal area the veins very pale and scarcely visible. Venation: *Rs* elongate, exceeding four times the basal section of R_{4+5}; supernumerary crossvein about its own length beyond *m*; cell *1st* M_2 elongate, longer than any of the veins beyond it and more than one-half longer than the distal section of vein M_3; basal section of M_3 a little less than twice *m*; *m–cu* about one and one-half times its own length beyond the fork of *M* or just beyond one-third the length of the lower face of cell *1st* M_2; vein *2nd A* slightly extended.

Abdominal tergites fulvous yellow, sternites clearer yellow; hypopygium, including the ninth tergite, dark brown.

Holotype, ♂, Torricelli Mountains, altitude 200–1,000 feet, January, 1939 (Cheesman).

The present fly is considered as being a race of *Limonia (Dapanoptera) candidata* Alexander (*pallida* de Meijere, preoccupied), described from the Noord River (Lorentz River) district of south-western New Guinea.

Tribe Hexatomini

LIMNOPHILA Macquart, 1834.

PAPUAPHILA subgen. nov.

Characters generally as in *Limnophila*, that is, with cell R_3 of wings present and deep, cell M_1 present; anterior arculus preserved. Antennae 13-segmented. Wings with *m–cu* near the inner end of cell *1st* M_2 or a short distance beyond the fork of M; vein *2nd A* unusually short, somewhat as in *Trichocera* but not as strongly curved. Ovipositor with cerci very long and slender.

Type of subgenus: *Limnophila selectissima* (Walker). Mysol.

Other included species are *Limnophila apicalis* de Meijere, of south-western New Guinea; *L. contingens* (Walker), of north-western New Guinea; *L. euchroma* (Walker), of Gilolo (Halmahera), and *L. terminalis* (Walker), of north-western New Guinea. All of the species described by Walker were taken by Alfred Russel Wallace.

In 1921, the late Dr. Fred. W. Edwards, of the British Museum, wrote me that the various Walker species above listed differed from all other described species of *Limnophila* and that he intended to propose for them a new generic group. This was never done and it seems advisable to erect the group at this time. I am giving it subgeneric ranking, with the realization that the accession of more materials may well result in elevating it to generic status. Undoubtedly, the group will be found to be a very characteristic one in the Papuan subregion.

Concerning the subgenotype, *selectissima*, the following supplementary notes on the type were sent to me by Edwards. Venation: *Rs* ending in cell R_2, that is, cell R_3 sessile; R_2 at midlength of anterior branch of *Rs*, that is, veins R_{2+3} and R_3 subequal; R_{1+2} one and one-half times vein R_2 alone; *m–cu* a little beyond the base of the short cell *1st* M_2.

It may be noted that both van der Wulp and Kertész place *Limnobia trisignata* Walker in the genus *Limnophila*, but from the rather satisfactory description it seems certain that this is a *Limonia* and probably a member of the subgenus *Libnotes*. Unfortunately, I have no notes by Edwards on this species nor did he include it as being a *Libnotes* in his discussion of the Oriental-Australasian species of this group (Journ. Fed. Malay States Mus., 1928: 74–80).

LIMNOPHILA (PAPUAPHILA) FUSCOABDOMINALIS sp. nov.

General coloration of thorax light yellow, restrictedly patterned with reddish brown, including three poorly indicated praescutal stripes; pseodosutural foveae large and conspicuous; legs brown, excepting the obscure yellow femoral bases; wings suffused with brown; R_{2+3+4} about one-half as long as the basal section of R_5, in direct longitudinal alignment with Rs; abdominal tergites obscure yellowish brown, patterned with darker brown, especially the outer segments; ovipositor with very long slender valves.

♀ Length, about 7·5 mm.; wing, 8 mm.

Rostrum and palpi brownish black. Antennae 13-segmented; scape and pedicel light brown, flagellum dark brown to brownish black; flagellar segments subcylindrical, a little dilated at near midlength; verticils long and conspicuous, the longest a little exceeding the segments in length. Head black, sparsely pruinose.

Pronotum obscure yellow, with a brown median line; both the scutum and the scutellum relatively large and massive. Mesonotum light yellow, restrictedly patterned with reddish brown, including three poorly indicated praescutal stripes, the central one narrower and more deeply coloured in front; pseudosutural foveae brownish black, large and conspicuous; tuberculate pits apparently lacking; centres of scutal lobes more or less darkened; median region of scutum and scutellum with brown areas; mediotergite almost uniformly yellow, vaguely patterned with darker near the middle of anterior portion. Pleura and pleurotergite chiefly obscure yellow. Halteres with stem yellowish brown, knob darker brown. Legs with the coxae brown; trochanters more brownish yellow; femora obscure yellow basally, the remainder of legs passing into brown; tibial spurs distinct. Wings with a brownish suffusion, the base and the stigma vaguely to scarcely darker; veins brown. Beyond cord all outer radial branches with abundant short trichia; M_1 and M_2 with fewer trichia. Venation: Sc_1 ending nearly opposite the fork of R_{2+3+4}, Sc_2 a little removed from its tip, nearly opposite the fork of Rs; Rs in longitudinal alignment with R_{2+3+4}, the latter only about one-half as long as the more arcuated basal section of R_5; cell M_1 from about one and one-half to nearly twice its petiole; m–cu subequal to the distal section of Cu_1, only a short distance beyond the fork of M; vein *2nd A* short, gently curved to the margin; anterior arculus preserved.

Abdominal tergites obscure yellowish brown, variegated with darker brown, more extensively so on the basal and apical tergites, the intermediate ones somewhat more brightened; sternites more uniformly yellow, the lateral borders narrowly infuscated; pleural membrane, terminal segment and genital shield dark brown. Ovipositor with the cerci orange-yellow, of unusual length and

slenderness, about equal in length to the combined four tergites preceding the genital shield.

Holotype, ♀, Torricelli Mountains, altitude 200–1,000 feet, January, 1939 (Cheesman).

The nearest relative of the present fly seems to be *Limnophila* (*Papuaphila*) *apicalis* de Meijere, which differs especially in the coloration of the body and legs.

ELEPHANTOMYIA Osten Sacken, 1859.

ELEPHANTOMYIA (ELEPHANTOMYODES) HYALIBASIS sp. nov.

Thorax almost uniformly obscure brownish yellow, the mesonotum with short but abundant erect setae; rostrum long, exceeding one-half the length of the wing; anterior vertex very narrow; wings with a strong brownish tinge, the costal border narrowly dark brown, the colour continued distad nearly to the wing tip; cell *M* in prearcular field clear hyaline, contrasting with the darkened costa; abdomen more or less bicoloured, black, with broad obscure yellow basal rings, only the eighth segment uniformly darkened; hypopygium yellow.

♂ Length, excluding rostrum, about 6 mm.; wing, 7·5 mm.; rostrum, about 4·5 mm.

Rostrum black, exceeding one-half the length of wing. Antennae black throughout; verticils very long. Head dark grey; anterior vertex very narrow, only about as wide as two rows of ommatidia, the eyes correspondingly large.

Thorax almost uniformly obscure brownish yellow; mesonotal praescutum and scutum with numerous but short, erect bristly setae, with somewhat fewer of these on posterior half of mediotergite. Pleura testaceous yellow, the anterior pleura more darkened. Halteres with stem pale brown, knob brownish black. Legs with all coxae brownish yellow; trochanters yellow; a single detached leg is affixed to the tab and may not belong to this specimen, as the setae are differently arranged than in other members of the subgenus; in this leg the tibiae and tarsi are uniformly blackened. Wings with a strong brownish tinge, the costal border, including cells *C* and *Sc*, as far distad as the termination of vein R_5 dark brown; very narrow to scarcely evident dark seams at origin of *Rs*, R_{2+3+4} and over the remainder of cord; cell *M* in prearcular field clear hyaline, constrasting conspicuously with the darkened costal portion; veins brown. Venation: *Rs* relatively long, exceeding in length cell *1st* M_2, square at origin; vein R_{2+3+4} perpendicular at origin, bent at virtually a right angle, thence nearly parallel to vein R_{1+2}, the portion of the cell above it uniformly darkened; cell *1st* M_2 large, rectangular, subequal to or a little longer than the distal section of vein M_{1+2}; *m–cu* nearly its own length beyond the fork of *M* and nearly as long as the distal section of vein Cu_1; cell *2nd A* narrow, more widened before midlength.

Abdomen more or less bicoloured, the first segment pale, the succeeding ones black, with broad basal rings of obscure yellow, only the eighth segment uniformly darkened; hypopygium brownish yellow.

Holotype, ♂, Torricelli Mountains, altitude 200–1,000 feet, January, 1939 (Cheesman).

Among the described regional species, the present fly agrees most nearly with *Elephantomyia* (*Elephantomyodes*) *tayloriana* Alexander, of New Britain, despite the black body coloration and distinctive wing pattern of the latter. The hyaline droplet before the arculus is noteworthy.

Tribe Eriopterini.

TRENTEPOHLIA Bigot, 1854.

TRENTEPOHLIA (MONGOMA) PRAESULIS sp. nov.

General coloration dark brown; legs dark brown, with more than the distal fourth of at least the middle tibiae snowy white and moderately enlarged; tarsi white, the proximal third of the basitarsi infuscated; wings whitish subhyaline; R_{3+4} long, subequal to R_2; *m–cu* before the fork of *M*.

♂ Length, about 6 mm.; wing, 7 mm.

Rostrum pale brown; palpi black. Antennae dark brown throughout; flagellar segments long-cylindrical, with numerous normal setae but without specially modified verticils. Head dark grey; anterior vertex reduced to a narrow strip.

Pronotum brown. Mesonotum chiefly dark brown, the humeral region of praescutum and lateral portions of the scutal lobes obscure yellow. Pleura brownish yellow. Halteres short, infuscated, the base of stem narrowly yellow. Legs with the coxae and trochanters yellow, the fore coxae somewhat darker; femora and tibiae dark brown, the genua not brightened; a single complete (middle) leg remains; distal fourth or more of tibiae snowy white, dilated, approximately twice as thick as the central portion of the sclerite, the vestiture snowy white; tarsi white, with nearly the proximal third of the basitarsi infuscated. Wings whitish subhyaline, the extreme tip vaguely infuscated; stigmal darkening very restricted, lying between veins *Sc* and *R*; veins brown. Venation: R_{1+2}, R_2 and R_{3+4} all subequal; cell R_3 relatively short, vein R_3 sinuous; cell *1st* M_2 somewhat shorter than vein M_4; *m–cu* a short distance before the fork of *M*; fusion of veins Cu_1, and *1st A* relatively extensive, more than one-half *m–cu*.

Abdominal tergites dark brown, the lateral borders narrowly yellow; sternites bicoloured, brownish grey, the posterior margins broadly yellow; hypopygium brown.

Holotype, ♂, Torricelli Mountains, altitude 200–1,000 feet, January, 1939 (Cheesman).

The present species is evidently allied to *Trentepohlia* (*Mongoma*) *australiensis* (Skuse), of north-eastern Australia, and to *T.* (*M.*) *subpennata* Alexander, of the Papuan subregion. The former has the tips of the femora and the bases of the tibiae extensively snowy white; the latter differs in the venation, as the length of vein R_{3+4} and in the even more strongly dilated apices of the middle tibiae.

TRENTEPOHLIA (ANCHIMONGOMA) ANGUSTICINCTA sp. nov.

General coloration of mesonotal praescutum, scutal lobes and pleura dark brown, the scutellum abruptly yellow; antennae black throughout; tibiae white, with a narrow black ring before midlength, on the posterior tibiae only a little more than one-half as wide as the white base; wings whitish hyaline, unpatterned; cell R_5 a little exceeding its petiole.

♀ Length, about 7·5 mm.; wing, about 7 mm.

Rostrum light brown; palpi black. Antennae black: flagellar segments cylindrical, with verticils that are subequal to or a trifle longer than the segments. Head above dark grey; anterior vertex reduced to a linear strip.

Pronotum concealed. Mesonotal praescutum and scutal lobes dark brown, contrasting with the yellow central portion of the scutum and the scutellum; postnotum weakly infuscated, sparsely pruinose. Pleura dark brown, sparsely pruinose, the posterior pleurites paler. Halteres with stem obscure yellow, knob infuscated. Legs with the coxae more or less infuscated, the bases restrictedly brightened; trochanters obscure yellow; femora dark brown, the bases narrowly white; tibiae white, with a relatively narrow black ring before midlength, broader on the middle legs where it is subequal to the white base, narrower on the posterior tibiae, where it is only a little more than one-half the white base (fore legs broken); remainder of legs white, the terminal two tarsal segments weakly darkened. Wings whitish hyaline, unpatterned, veins brown. Venation: As in the subgenus; R_{2+3+4} about two and one-half times R_2, the latter a little longer than R_{1+2}; cell R_5 a little exceeding its petiole; *m–cu* at fork of M; veins Cu_1 and *1st A* narrowly separated at margin, the distance about one-half the basal section of vein M_{1+2}.

Abdomen filled with eggs and evidently discoloured; dark brown, sparsely pruinose; ovipositor with the genital shield and valves reddish horn colour.

Holotype, ♀, Torricelli Mountains, altitude 200–1,000 feet, January, 1939 (Cheesman).

The present fly is closest to the Oriental *Trentepohlia* (*Anchimongoma*) *apoicola* Alexander (*niveipes* Edwards, preocc.) which differs chiefly in the darker wings and, especially, in the great increase in black colour on the tibiae.

THE HEAVY WOODEN SHIELD OF MISIMA, PAPUA

BY H. K. BARTLETT

Summary

The island of Misima (St. Aignan) stands a little apart from the other islands of the Calvados Chain in the Louisade Archipelago, south-eastern Papua. Its coral cliffs rise abruptly from the sea. Mount Oiatau (oia=mountain, tau=man) rises to about 3,400 feet on the narrow western end. Just off-shore charts record sea depths of 900 fathoms. The mountain range traverses the island, dwindling to a series of lesser peaks on the eastern end, where gold-bearing reefs have been located.

Misima today carries a population of about 2,800 people of Papuo-Melanesian stock, all of whom live in coastal villages. However, stories have been handed down of days when densely populated villages were numerous inland, as well as on the coast. Prior to the appearance of the white man, constant raiding and intervillage fighting appears to have been the order of the day.

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Fig. 1–2.

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Misima to-day carries a population of about 2,800 people of Papuo-Melanesian stock, all of whom live in coastal villages. However, stories have been handed down of days when densely populated villages were numerous inland, as well as on the coast. Prior to the appearance of the white man, constant raiding and intervillage fighting appears to have been the order of the day.

During this warfare the most characteristic weapon in use, besides spears and stones, was a heavy wooden shield, borne by an otherwise unarmed shield-bearer, who preceded files of spearmen when engaged in combat.

In July, 1941, shortly after an old and damaged shield had been first noticed in Baloma village, four of these heavy wooden shields were obtained from the natives of Awaibi village. A sixth and the best example seen, was buried with Togu, an old man of Lapipai village who died shortly afterwards. The shields are rare and, although careful inquiries were made, the one buried with Togu was stated to be the last one remaining on the island. All others had been buried with their former owners or destroyed.

The shields examined and those obtained were of relatively uniform size, approximately 20 inches by 36 inches, and about 1¼ inches thick at the centre; subrectangular, with the sides parallel and the ends rather evenly rounded. Two of them weigh 12 lb. each. The timber commonly used was taken from the heavy plank-like buttress roots of a type of fig tree. The broken shield first seen at Baloma village was, however, made from a very light wood.

An old native informant, Tomiarati by name, related how, in the days before white occupation of the island, he had been a shield-bearer for the natives of Lapipai village; he gave a demonstration of his skill in handling the heavy piece of wood. The shield, which was slightly convex to add to its efficiency in deflecting

spears, was supported on the arm by fresh loops of cane which were wound through the two lines of rectangular holes. When about to be used numerous small shells (*Caput serpentis, Arabica* and other small cowries), together with rattle pods and pandanus leaves, were suspended from the small holes appearing

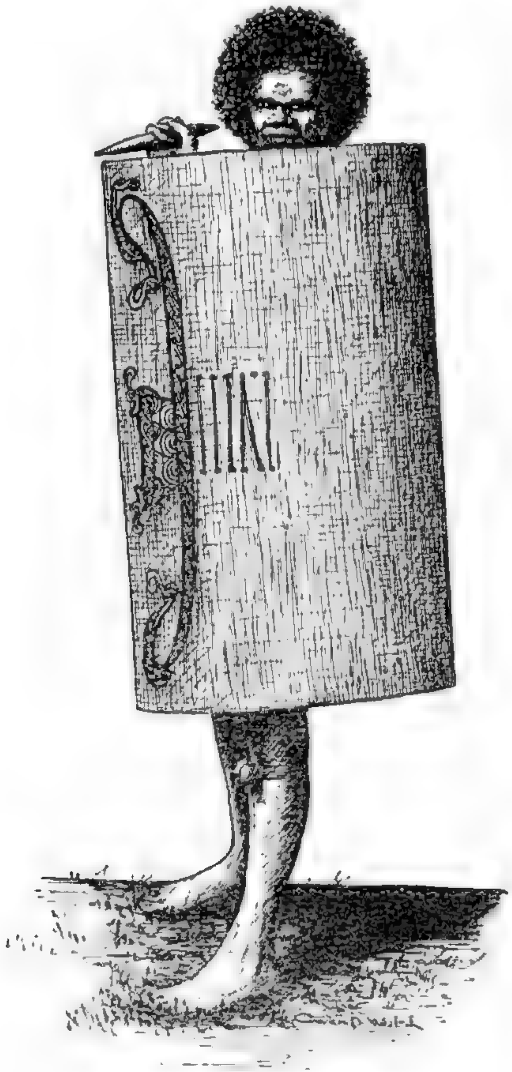

Fig. 1. Method of holding heavy wooden shield (drawn from a photograph).

along each lateral edge. The object of these decorations was to assist in making as much noise as possible and thereby to create an impression in the minds of the enemy that a large party of warriors were approaching. Since the shield was difficult to handle in jungle country, a shield-bearer was unable to carry any other weapon. A raiding party which could spare four or five men to act as shield-bearers must be strong in numbers. Tomiarati said that a really expert shield-bearer was one who could so use his rattles as to create the impression that

the noise was caused by more than one bearer. Going in front of the spearmen, his task was to ward off spears and stones flung by the enemy. In combat the shield-bearer was very active, making many leaps into the air to deflect flying missiles. In so doing he drew up his legs, so that at no time was any part of his body visible to the enemy.

On Misima the name given to the heavy fighting shield is "ivan." Panaeati folk call it "ligovan." Both these names were said to describe the shield as "upright." Other Misima words for "shield" are "ebwein" and "libweiu," but it was not possible to learn whether or not these names applied formerly to some other type of shield.

A carved design appears along one lateral margin of each shield. The designs of all figure birds and snakes. No totemic significance was claimed for the designs, which were in each case described as "to siba wana nuata," that is, "skilled man his thoughts." It is possible that the designs are actually of totemic origin, although their significance may have been forgotten by a generation that has lost a great deal of the old culture.

The principal and strongest totemic group on Misima was known as Tawaraian. They claimed as their bird the frigate (lawat), and as their reptile, the iguana (kumakara). Other totemic groups each laid claim to a bird and to a fish, but knew nothing of any reptile totem, although there was a hazy recollection of some kind of a plant totem.

A shield very similar to these Misima ones is in the National Museum, Melbourne, from Ware (Teste Island), about 100 miles to the west of Misima. In shape and design it is similar to Misima ones, but it is much smaller. It may be of significance that the language of Ware has a closer relationship with that of Misima than any other Louisiade Archipelago dialect.

Macgillivray (Voyage of "H.M.S. Rattlesnake," 1852. Vol. I, p. 272) describes a war dance carried out by a man at Brumer Island: "In one hand he held a large wooden shield, nearly three feet in length and rather more than one in width, and in the other a formidable-looking weapon two feet in length—a portion of the snout of a saw fish with long sharp teeth projecting on each side. Placing himself in a crouching attitude, and holding his weapon in a position to strike, he advanced rapidly in a succession of short bounds, striking the inner side of the shield with his left knee at each jerk, causing the large cowries hung round his waist and ankles to rattle violently." Macgillivray does not mention rattles attached to the shield.

Ratzel (*History of Mankind*, Butler's Translation. Vol. I, p. 235. 1896) figures from Teste Island a shield which shows elaborate shell decorations. He states that in "eastern New Guinea and the island to the east, specimens occur of great size, weighing up to twenty-two pounds and beautifully decorated."

William Powell (*Wandering in a Wild Country.* 1883) describing a visit to Heath Island says (p. 13) ". . . we bought a good many implements of war, tomahawks, spears, clubs and shields." (p. 15) "The shields are black with white markings on them. They are about three feet long and two feet broad, slightly curved at the sides; these are hung on the outrigger of the canoe to form a bulwark when fighting." In Possession Bay, Hayter Island, about 300 canoes crowded around Powell's vessel, while two war canoes cruised on the outer circle. These war canoes were "very long, holding about thirty men each, the outriggers hung with shields and bundles of spears." (p. 17.)

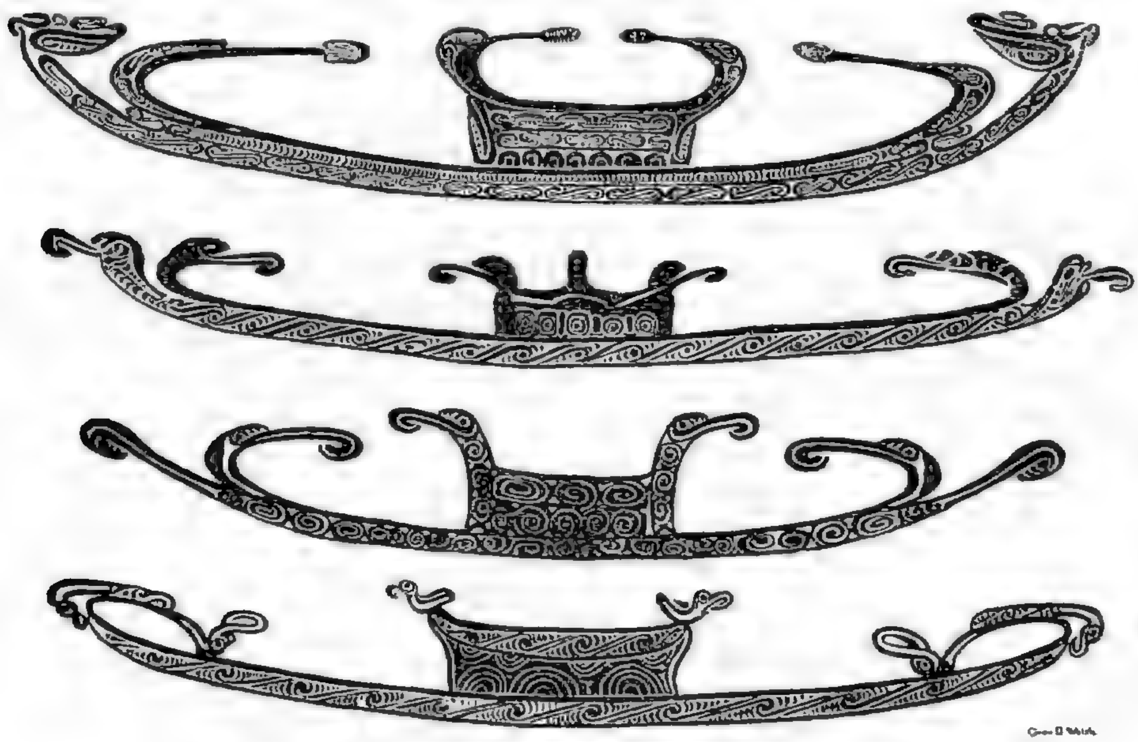

Fig. 2. Patterns from four heavy wooden shields.

Powell gives a figure of a shield from Hayter Island (p. 17) which, says Haddon (*Decorative Art of British New Guinea*, p. 215) "does not give me the impression of being a faithful representation."

The form of shield found between East Cape and Astrolabe Bay is similar to those from Misima. Comrie (*Journal of the Anthropological Institute of Great Britain*, vi, 1877, pl. 1, fig. 9) shows an example with one lateral margin decorated with shell discs strung on three lines of cord. The dimensions are given as 33 inches by 14 inches. The carved design is entirely different, but the shape is close to those of Misima.

Mr. N. B. Tindale (Ethnologist of South Australian Museum) has made the following comments: "Edge-Partington (Album of the native weapons . . . of the natives of the Pacific Islands, i, 1890, pl. 283, fig. 4) illustrates a specimen of this Misima type of shield, labelled only as from 'New Guinea.' It measures 19 inches by 34 inches and its markings, so far as can be determined, were similar to those of the shields described herein. It is referred to as a 'heavy canoe shield of wood, painted black and decorated with carving and pigments.' A manuscript note in the South Australian Museum copy of this work, by the late Sir Edward Stirling, indicates that similar shields were known from 'Teste Island and in use at the southern end of the Peninsula."

"Although it is clear from details given of the method of use on Misima that these shields were employed as 'upright' land combat weapons, the carved design on one lateral margin helps to confirm other descriptions of them, including Edge-Partington's, as canoe shields. In such case they may well have been employed with the decorated margin upwards. The usual presence of two seemingly vestigial medium projections or lugs on the face of several of the shields may be connected with some such former use. It will be noted that on one of two shields available for inspection at Adelaide, these projections are absent. The design on this shield, however, is less finished than on others, and may represent a later example."

A NEW RACE OF TISIPHONE ABEONA DONOVAN (LEPIDOPTERA RHOPALOCERA) FROM SOUTH AUSTRALIA

BY NORMAN B. TINDALE, B. SC., ETHNOLOGIST, S. A. MUSEUM

Summary

The Satyrid Tisiphone abeona Don. 1805 illustrates more than most Australian butterflies the interesting phenomenon of the formation of a whole series of geographical races within the limits of a continental area. Waterhouse (1922, 1923, 1928) demonstrated by genetic studies and by hybridization experiments, that several forms of this butterfly, once thought to belong to more than one species, were all races of a single polytypic species. Each of the races is geographically isolated from the next by a wide or narrow zone of country outside the oekomene of the species. Such isolating areas are notable either for the unsuitability of the climate, the absence of native sword grasses (Gahnia psittacorum, G. aspera and G. microstachya), the characteristic foodplants of the butterfly, or for unsuitable climate combined with lack of foodplants.

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Plate xix.

The Satyrid *Tisiphone abeona* Don. 1805 illustrates more than most Australian butterflies the interesting phenomenon of the formation of a whole series of geographical races within the limits of a continental area. Waterhouse (1922, 1923, 1928) demonstrated by genetic studies and by hybridization experiments, that several forms of this butterfly, once thought to belong to more than one species, were all races of a single polytypic species. Each of the races is geographically isolated from the next by a wide or narrow zone of country outside the *oekomene* of the species. Such isolating areas are notable either for the unsuitability of the climate, the absence of native sword grasses (*Gahnia psittacorum, G. aspera* and *G. microstachya*), the characteristic foodplants of the butterfly, or for unsuitable climate combined with lack of foodplants.

Hitherto known races are:

Tisiphone abeona rawnsleyi Miskin, 1876. South Queensland at Maroochy, Mooloolah and Caloundra.

Tisiphone abeona morrisi Waterhouse, 1914. North-eastern New South Wales between the Macleay and Tweed Rivers.

Tisiphone abeona regalis Waterhouse, 1928. New South Wales, at Barrington Tops and the Dorrigo Plateau at elevations up to 4,000 feet.

Tisiphone abeona joanna (Butler, 1866). New South Wales, within a radius of approximately 15 miles of Port Macquarie.

Tisiphone abeona aurelia Waterhouse, 1915. New South Wales, between Port Stephens and Camden Haven.

Tisiphone abeona abeona (Donovan, 1805). New South Wales coastal districts at Newcastle, Ourimbah, Sydney and Illawarra; also in the Blue Mountains.

Tisiphone abeona albifascia Waterhouse, 1904. South-eastern New South Wales from Narooma to Wilson Promontory, and eastern Victoria at Ferntree Gully, Wandin, Healesville, Mt. Macedon and Lorne.

There is one other *Tisiphone, T. helena* Olliff, 1888, which lives in the Cairns district of north Queensland at altitudes about 1,200 feet, on Mt. Bellenden-Ker, and at Herberton and Karunda. *T. helena*, although generally listed as a separate species, seems to belong to the polytypic *T. abeona*.

The races of *T. abeona* differ from each other in various degrees, a gradient between the forms being such as to bear a rather direct relationship with the widths of the gaps between their respective areas of distribution. *T. a. helena* being separated by nearly 600 miles from its neighbour, *T. a. rawnsleyi*, is also one of the most distinctive of the forms. *T. a. rawnsleyi* and *T. a. morrisi* also are different in appearance and are very stable forms, occupying separate areas. *T. a. rawnsleyi* is melanic, *T. a. morrisi* the most albinic of the races. South of the area occupied by *T. a. morrisi* is *T. a. joanna*. This is most unstable as to wing pattern, no two examples being taken which are exactly alike. Waterhouse has shown the great probability that *T. a. joanna* arose as a natural hybrid during recolonization of the Port Macquarie district by elements of two formerly separated subspecies, *T. a. morrisi* and *T. a. aurelia*. He supported his deductions by a series of hybridization experiments, and in the F_2-generation of *morrisi* x *aurelia* crosses, reproduced the highly variable complex of forms typical of the natural *T. joanna* population.

Three southern races, *T. a. aurelia*, *T. a. abeona* and *T. a. albifascia*, are rather similar as to markings; their areas of distribution are close together and the transition from one race to the next is less clear cut than in more northern races. In the extreme south-east of the continent *T. a. albifascia* occurs, chiefly along the coast from Narooma to Wilson Promontory and extending westwards in pockets of favourable country as far as Mt. Macedon, Ferntree Gully and Lorne. The race is two-brooded, with a spring brood emerging in November and early December and an autumn one during February and March.

During a recent holiday visit to the south-east of South Australia it was of some interest to find a new race of *Tisiphone abeona*, allied to both *T. a. albifascia* and *T. a. abeona*, flying in a relatively restricted area of about two square miles within the limits of the volcanic crater lake basin, known as Lake Edward. This locality is over 200 miles west of the previously known western limit for the species, at Lorne, Victoria. Further collecting revealed the presence of the same form at Dartmoor on the Glenelg River, just over the border in western Victoria, but still leaving a belt of country over 175 miles in width in which apparently it does not occur. Since this paper was prepared Dr. A. V. Southcott has given me a specimen from the Grampians.

A formal description of the new race is as follows:

TISIPHONE ABEONA ANTONI subsp. nov.

Male. Wings above black; forewings with two blue-pupilled black eyespots each with a tiny white central dot; a broad orange band across midwing and a narrower one near apex; the latter is distinctly wider and cream coloured near

the costal margin; hindwings with a large eyespot near hinder angle, this is ringed with dull orange brown and black; traces of an eyespot near apex; wings below with markings arranged as above; forewings with midwing band orange in lower half, cream-toned in cell; band near apex cream-coloured, traces of two white lines parallel to outer margin; hind wing black with two large eyespots, each ringed with orange brown, that near apex with traces of a small second one below it; a broad cream-coloured band across midwing and two narrower ones near outer margin. Expanse 66 mm.

Female. Generally larger, wings more ample, markings similar but paler; midwing band of forewing tends to a cream-tone in cell; the hind wing above bears traces of a dusky cream band across the wing in the position of the broad white fascia beneath. Expanse 75 mm.

Loc. South Australia: *Lake Edward* (Holotype a male, and allotype female numbered I 18,951 in South Australian Museum), caught 3rd–4th January, 1947, by N. B. and A. J. Tindale. Victoria: Dartmoor, 10th January, 1947, N. B. Tindale. Mackenzie Creek, Grampians, 26th December, 1931, A. V. Southcott. 4 Males, 3 females.

The type and allotype of *T. a. antoni* are deposited in the South Australian Museum, together with three paratypes; one paratype each has been passed to the Australian Museum, Sydney, and the National Museum, Melbourne.

At Lake Edward the butterflies were rather rare and fast flying, frequenting the clumps of giant *Gahnia* grass which grow on the somewhat treacherous surface of peat bog fringing the lake on its southern side and western shores. Two days assiduous collecting yielded only four specimens, although many times that number were seen. The season of emergence was evidently well advanced and most examples seen were ragged or had suffered from symmetrical wing injuries, apparently as a result of the attacks of birds.

At Dartmoor, on 10th January, 1947, the butterflies were found, flying about clumps of giant *Gahnia* growing among teatree (Melaleuca) about the sources of several springs which originate in the base of the *Ostrea bed* (of probable Pleistocene age), and flow down by small lateral valleys to the main stream of the Glenelg River. The season for the species was well advanced and most of the examples were ragged. A half-day's collecting yielded only two specimens.

This race, in keeping with its greater apparent isolation, seems to differ a little more from *T. a. abeona* and *T. a. albifascia* than those two races differ from each other. This is, perhaps, to be expected, since the ranges of the latter tend now to a slight overlap in the vicinity of Narooma. Recent gene exchange may have occurred between the two forms along the meeting ground, as has clearly happened in the case of the race *T. a. joanna.*

A conspicuous difference between *T. a. antoni* and *T. a. abeona* in the male is seen in the cream colour of the costal portion of the subapical spot; *T. a. albifascia* shows this to a degree. In the female the cream colour of that part of the median band lying within the cell is highly distinctive. The median white band of the hindwing beneath, in both sexes, is as conspicuous as in *T. a. albifascia* and the inner of the two submarginal ones is even more developed. The orange-brown colour of the eyespots tends to be like *T. a. aurelia*; the brown-ringed spots in both sexes are relatively smaller than in *T. a. albifascia* and more like those of *T. a. abeona*. The size difference is particularly noticeable in the case of the subapical spot of the hindwing beneath.

THEORETICAL DISCUSSION.

Some pertinent deductions are possible from a study of the distribution of the races of *Tisiphone*, significant because they point up, firstly the influences of changing climate, and secondly the operation of the age and area effect, whereby the most primitive and distinctive form of this polytypic species complex, namely, *T. a. helena* occurs on the isolated northern periphery of the area of distribution while the least distinctive races and latest developed ones occur near the focus about southern New South Wales. It is evident that the distribution of *Tisiphone* is controlled by relatively critical moisture and temperature limits. Its tolerances are such that while it lives near sea level on Wilson Promontory near the southern limit of its distribution, as one goes north it finds its climatic equivalent at some elevation, on mountains. Thus it occurs on Barrington Tops in New South Wales, and still further north only on the plateau of the Atherton Tableland, where it can find a temperature range and humidity suitable for it, only at elevations above 1,000 feet.

The distribution of the species is one which seems likely to have been susceptible to alteration by changes of climate, such as everywhere have characterized the Pleistocene and Recent Periods. Periods of increasing cold in Southern Australia would have tended to drive the species north, away from areas of extreme cold. It does not occur in Tasmania now, although present conditions would probably favour its living there were it to become established. Since Tasmania is postulated to be in a stage of recovery from a period of extreme cold (glaciation of Würm III), it would appear possible that *Tisiphone* was once driven out and has not yet had time to recolonize an area where its foodplant exists at the present time.

The immediate past history of Australia has apparently been one of increasing warmth. In the more southern parts this change first took the form of an amelioration of a cold wet climate which may now be passing over into a drier

and less favourable phase. As a result of this progressive change, *Tisiphone abeona* was first able to colonize a broad area from eastern Victoria to South Australia, and then with the onset of a decline in these favourable conditions, the southern colony of *Tisiphone* became divided. This division took place a sufficiently long time ago to have permitted the development of recognizable differences of apparent subspecific status. In view of the relatively brief period likely to be involved (only portion of time between Würm III and the present at a maximum), it is suggested that *T. a. abeona* may be a relatively unstable or rapidly mutating form, as well as one very sensitive to climatic changes.

The South East of this State, wet and humid though it seems by South Australian standards, might have been considered generally too inhospitable a locality for a member of such a sensitive genus as *Tisiphone*. The area within the crater or subsidence area about Lake Edward appears to constitute a relict niche which has preserved traces of a "wet" flora and fauna once more widely spread in the South East. The very presence of this butterfly is an argument in support of an immediately prior period of high humidity rather than a drier one. In fact, if dry conditions had been present, it is likely the species would have become extinct. The race also occurs on the Glenelg River at Dartmoor, where similar conditions of moisture and relatively high humidity occur in pockets within the meandering valley.

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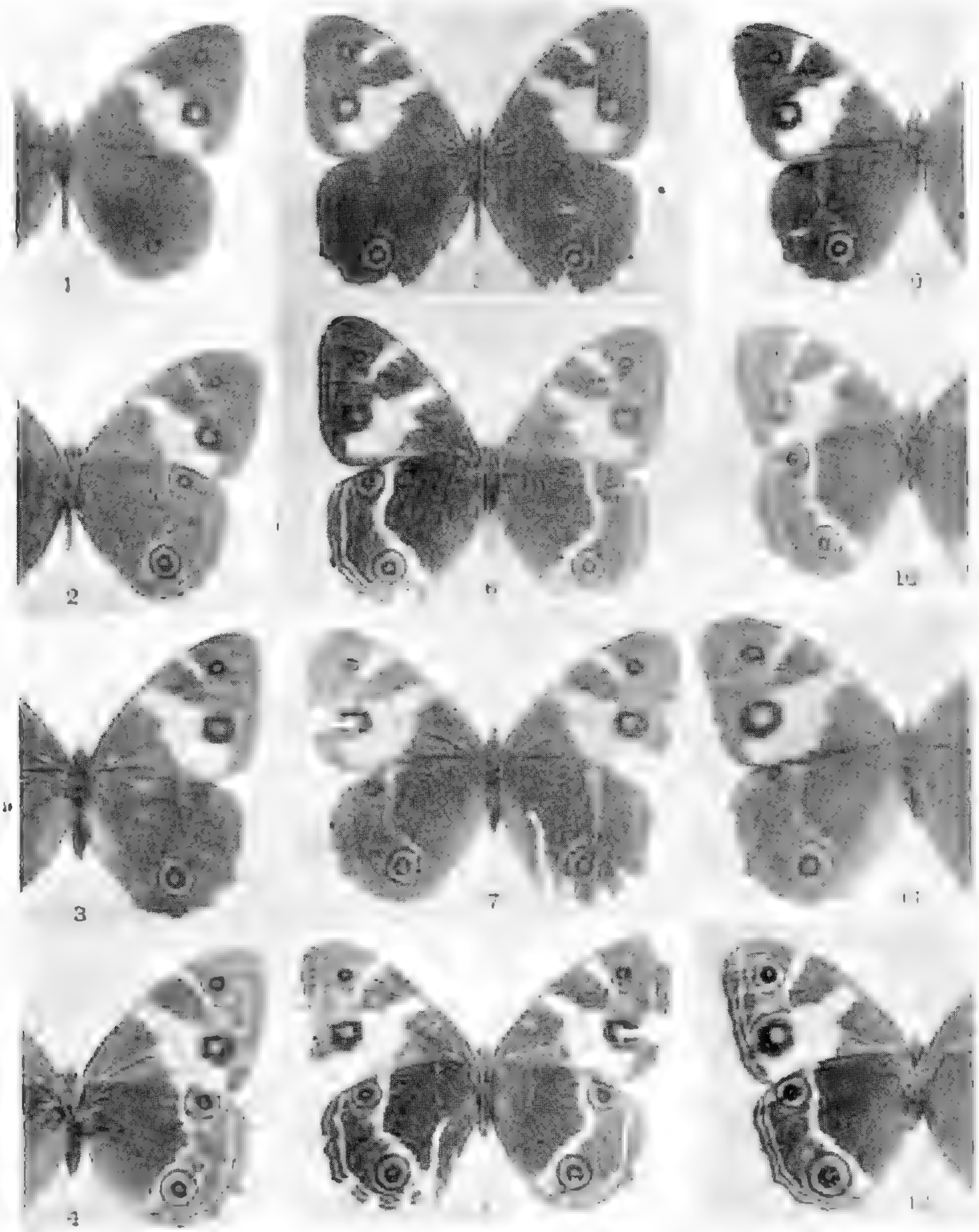
EXPLANATION OF PLATE.

Plate xix.

Fig. 1. *Tisiphone abeona abeona* Donovan, male, Sydney, September, upper side.
Fig. 2. *Tisiphone abeona abeona* Donovan, male, Sydney, September, under side.
Fig. 3. *Tisiphone abeona abeona* Donovan, female, Waverley, October, upper side.
Fig. 4. *Tisiphone abeona abeona* Donovan, female, Waverley, October, under side.
Fig. 5. *Tisiphone abeona antoni* Tindale, holotype male, Lake Edward, January, upper side.
Fig. 6. *Tisiphone abeona antoni* Tindale, holotype male, Lake Edward, January, under side.
Fig. 7. *Tisiphone abeona antoni* Tindale, allotype female, Lake Edward, January, upper side.
Fig. 8. *Tisiphone abeona antoni* Tindale, allotype female, Lake Edward, January, under side.
Fig. 9. *Tisiphone abeona albifascia* Waterhouse, male, Emerald, November, upper side.
Fig. 10. *Tisiphone abeona albifascia* Waterhouse, male, Emerald, November, under side.
Fig. 11. *Tisiphone abeona albifascia* Waterhouse, female, Emerald, November, upper side.
Fig. 12. *Tisiphone abeona albifascia* Waterhouse, female, Emerald, November, under side.



SUBDIVISION OF PLEISTOCENE TIME IN SOUTH AUSTRALIA

By Norman B. Tindale, B. Sc., Ethnologist, S. A. Museum

"The only sound approach to a study [of the early tools of man] is through those natural sciences which are concerned with the chronology of the Pleistocene."
Movius (1944).

Summary

This paper brings together new evidence for, and recent work on, the subdivision of Pleistocene time, as it applies to South Australia. It is intended as a preliminary to a study of the advent of man on this continent; only geological information is made use of in establishing the subdivisions.

Using index fossils Haug (1911) defined the Pliocene-Pleistocene boundary, with some precision, as that indicated by the appearance of the mammalian genera Elephas, Equus and Bos, the so-called Villafranchian fauna. Determined at first only for Europe this dividing line is coming to be accepted by other workers as applying equally well to Asia. However, such a correlation cannot be transferred directly to the Australian Region, which lies outside areas which were accessible to the migrations of the later mammals.

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INTRODUCTION.

This paper brings together new evidence for, and recent work on, the subdivision of Pleistocene time, as it applies to South Australia. It is intended as a preliminary to a study of the advent of man on this continent; only geological information is made use of in establishing the subdivisions.

Using index fossils Haug (1911) defined the Pliocene-Pleistocene boundary, with some precision, as that indicated by the appearance of the mammalian genera *Elephas, Equus* and *Bos,* the so-called Villafranchian fauna. Determined at first only for Europe this dividing line is coming to be accepted by other workers as applying equally well to Asia. However, such a correlation cannot be transferred directly to the Australian Region, which lies outside areas which were accessible to the migrations of the later mammals.

Arrival of a Villafranchian fauna in southern Asia was linked directly with a deterioration of climate, marking the onset of the Early (Günz) Glacial Period. Further, from the Caucasus to Eastern Asia an angular unconformity is encountered, according to de Terra (1940), forming an abrupt structural break in the Cainozoic sequence. This break was marked by widespread diastrophic events which in turn led to new cyclic processes of erosion and peneplanation of the first order of magnitude.

Such diastrophic happenings may have been world-wide. They recall the Kosciusko plateau building movements of eastern Australia, which at one time were thought to be dated chiefly within the Pleistocene itself. Later opinions, commencing probably with Hills (1934) have tended to place the Kosciusko phase further back, either at the beginning of the Pleistocene or earlier.

A limited correlation between events in Asia and Australia might be sought by linking the late Pliocene diastrophism of the one with the plateau building of

the other, as a starting point for a subdivision of the Australian Pleistocene based on faunal changes. Even were this association clearly established, faunal studies do not present any very detailed or workable scheme.

Subdivision of the period by the use of index fossils has not been successful principally owing to the relatively short time intervals involved.

Students of Mollusca, for example, tend to minimize the changes observable between various Cainozoic shell faunas, and ascribe them rather to local ecological differences than to true faunal breaks. This is not to say that limited correlations may not be possible through the use of evidence based on relatively plastic fresh-water forms such as *Paludina*. Better results seems to have been achieved by using suites of species, occupying specific ecological niches, as climatic and geomorphic indicators.

A key to the subdivision of the Pleistocene in Australia seems available in the series of apparently eustatic shorelines, preserved on the virtually stable low level karst plateau of the South East of South Australia. This vast, horizontally-bedded limestone region was the almost insensibly sloping floor of a Tertiary sea which bit deeply into the eastern part of South Australia. Old shorelines laid down on this shelf and preserved in limestone, are found as much as 50 miles inland from the present shore. They run in almost unbroken array between the present Murray River and the Glenelg River, a lateral distance of well over 200 miles. Some of them can be traced for even greater distances along the southern coast of Australia.

The eustatic nature of this series of ancient shorelines was only relatively recently recognized, by Tindale (1933), who made direct correlations with Pleistocene marine interglacial terraces observed by Cooke (1930), on the stable foreshore of the south-eastern coast of the United States.

New evidence has accumulated and additional survey data on terrace heights has become available. The principal conclusions arrived at in 1933 now appear to have been endorsed by work in other parts of the world. The present author has been able to live in some of the classical localities for eustatic terraces on the south-east coast of the United States and to compare the types of evidence available in the two areas. This paper continues the discussion in the light of these additional facts and outlines a tentative local time scale for the Pleistocene.

SUMMARY OF RECENT WORK.

Among the many papers published since 1933 on the subject of eustatic terraces, are several having a direct bearing on the present problem.

Ward (1941) gave an E–W section of the South East of South Australia from Robe to the Hundred of Comaum. Readings of terrace heights derived

from this section reduced to datum (Low Water Outer Spring Tides, Port Adelaide) are:

Naracoorte	Not shown
Cave	175 feet (54 metres)
Baker	150 feet (45 metres)
East Avenue	122 feet (38 metres)
West Avenue	90 feet (28 metres)
Reedy	83 feet (26 metres)
Dairy	29 feet (9 metres)
Woakwine	21 feet (6·5 metres)
Present Coast (inland side of)	4 feet (1 metre)

The heights of these terraces in general check with those given by Tindale 1933, save Cave Range, which is shown as 175 feet, as against the earlier estimate of 200 feet. Baker Range was regarded by Tindale as the earliest phase of his East Avenue Terrace, while Dairy Range is a portion of his Woakwine complex.

Ward examined the possibility of these terraces being eustatic terraces, but following earlier expressed views reiterated that they were the results of intermittent epeirogenic movements of uplift on a regional scale. One or more terraces were considered to be fault lines developed in Post-Tertiary times, and "due to the relief of the epeirogenic stresses developed in the general uplift of the region." Difficulty was seen in reconciling the apparently orderly succession of terraces with the relative lengths of past interglacial periods. "Should proof be forthcoming that the oldest ridge lies farthest inland, and that each successive ridge is younger than that more remote from the sea, it would appear that the hypothesis of purely eustatic control under glacial influence must be abandoned."

In the light of other work these objections may be less valid, since they are common to other eustatic shorelines on stable foreshores.

Edwards (1941) after studying the north-west coast of Tasmania came to the conclusion that its submergent and emergent features were due largely to successive eustatic rises and falls of sea level during the Glacial and Post-Glacial periods. No one stage of either high or low sea level was maintained sufficiently long to allow the coastline to mature so that it is made up of youthful features of submergence combined with youthful features of emergence. East of Devonport the shore features due to submergence tended to dominate, evidence that this part of Tasmania was well sheltered from marine erosion except during interglacial highs. West of Stanley the shore features, due to emergence, were the more prominent.

Edwards gave records of high terraces at many places along the north coast

of Tasmania. At Jacob Boat Harbour, for example, there are two high shore platforms, one at 10–15 feet (3–4·5 metres) above sea level, the other at 40–50 feet (11–15 metres), backed by a basalt-capped scarp representing the old cliff line.

Two sea caves on opposite faces of Rocky Cape are cut into cliffs of white quartzite. Aboriginal kitchen midden deposits cover their floors, in one case to a depth of 10 feet (3 metres) and in the other to 20 feet (6 metres); the bases of the caves are at 50 feet (15 metres) above sea level and their ceilings are up to 30 feet (9 metres) higher.

Edwards considered that remnants of three shorelines can be found all along the north-west coast, one at 5–15 feet (1·5–4·5 metres) above sea level, another at 40–50 feet (11–15 metres) above it; also traces of a third at about 100 feet (approximately 31 metres). He observed the probable existence of a submerged shoreline between –120 feet and –150 feet (–37 to –45 metres), and indications of another still older prebasaltic submerged strandline.

In view of the evidence afforded by the sea caves at Rocky Cape it is possible that Edwards should have placed his 40–50 feet strandline at a minimum of about 50–60 feet (15–18 metres) above sea level. Also, since similar methods were used to estimate the height of the lower terrace, it should perhaps be read as at 15–25 feet (4·5–6 metres) rather than 5–15 feet above sea level. The evidence for his terrace at about 100 feet (31 metres) may receive support from the early work of Johnston (1888) who recorded raised beaches at about 100 feet above sea level on Chappell Island in Bass Strait.

Summarized Edwards' conclusions were:

Günz Glacial	Pre-basaltic submerged strandline
Mindel Glacial	Forth Valley formed
Mindel/Riss Interglacial	100 to 150 foot terrace
Riss Glacial	–120 to –150 feet submerged terrace
Riss/Würm Interglacial	40–50 feet terrace
Würm Glacial	no reference made
Post-Glacial	5–15 feet terrace

Lewis (1945) in posthumously published notes edited by D. E. Thomas, summed up over a decade of work on glaciation in Tasmania. He regarded the beginning of Pleistocene time in Tasmania as prior to the onset of glacial conditions. He identified as pre-glacial a "Launceston Stage" with two relatively contemporary floras featuring *Nothofagus* and *Eucalyptus* respectively, indicating either relatively mild damp or even warm conditions as then prevailing in Tasmania. Immediately following the Launceston Stage came a lowering of sea level, of the order of 350 feet (108 metres), leaving a terrace which he claimed to

have observed at the same elevation throughout Tasmania. This, his Malanna Glacial Stage, was the first low water phase of the Pleistocene, there being, according to him, no evidence of any pre-Malannan low water phase. Roughly, contemporaneously flooding of the low lands occurred all round the coastline of Tasmania. Both the emergence and the flooding were seemingly expressions of eustatic variations of sea level; the emergence began with his first glacial (Malannan) and the flooding during a subsequent interglacial (the Millbrook Rise). Lewis identified as of Malannan date a trough in the River Derwent estuary which extends to 150 feet (–45 metres) below present sea level, giving an indication of a possible minimum condition of the lowering of sea level during his Malannan times. He found little or no evidence of differential movement such as could be assigned to a post-glacial (i.e. Post-Malannan) isostatic recovery from ice loading (as postulated by David, 1924), but implied some movement was due to tectonic activity on a regional scale. During his Millbrook Stage river gravels were deposited to an *average* height of 150 feet (45 metres) above present sea level.

Subsequent to the Millbrook phase, which is specifically maintained as embracing the "longest of the Tasmanian interglacial periods," Lewis placed a younger, and lesser, Yolande glaciation which, he concluded, appeared in two distinct phases, separated by an interglacial interval. Associated with the Yolande glacials was a shoreline identified as approximately 60–80 feet (–18 to 25 metres) below present sea level. Following the Yolande glacials came an interglacial phase characterized by the 15 feet (4·5 metres) raised beaches first recorded by Darwin (1876) at Ralph Bay. Lewis states that the Ralph Bay terrace is a universal feature of Tasmania, extending impartially in cliff faces exposed to heavy seas and in estuaries where waves never occur. Following the Ralph Bay interglacial came the Margaret Glacial, less extensive than either Yolande or Malannan glacials and affecting only mountain areas, down to 2,200 feet in western Tasmania and to 3,700 feet in the east.

Associated with Margaret Glacial times was a low water phase which permitted present day streams to cut channels down to 15–21 feet (–4·5 to –6·5 metres) below present sea level, exposing sections of Ralph Bay Stage terraces. Other than this evidence there was little conclusive data to show that Margaret glaciers were not retreat features of the greater Yolande glaciations. Lewis decided, on the general appearances of freshness, that Margaret glaciers existed at a period far closer to the present day than the time interval between Yolande ice and the Margaret ice.

Lewis did not make any suggestions for direct correlation with glaciations elsewhere.

Zeuner (1935, 1942, 1945) in a series of papers culminating in a monographic

study of Pleistocene time, issued by the Ray Society, concluded that eustatic interglacial terraces were world-wide phenomena. He indicated relatively close agreement between the heights of principal terraces observed on stable foreshores in places so far removed as North America, North Africa, the Italo-French Riviera, the Sunda Islands and South Australia. He adopted as type names for the main interglacial terraces, those first determined in the Mediterranean area by Depéret (1906, 1918). Tentative correlations given by him as between his type terraces and the South Australian ones of Tindale were as follows:

Type names for interglacial terraces (Zeuner)	Average heights (metres).	Sth. Aust. interglacial terraces (Tindale).	Observed heights (metres).
Sicilian	100	Naracoorte	?
	(80)		(75)
Milazzian	60	Cave	60
			(45)
Tyrrhenian	32	East Avenue	27*
Main Monastirian	18	West Avenue Reedy	19·5
Late Monastirian	7·5	Woakwine	7·5
Present	0	Recent	0

* 27 metres as quoted by Zeuner, but 45 metres in the original paper; the latter height was revised by Crocker and Cotton (see below) to 32–34 metres.

On the evidence of submarine terraces and the data deduced from the benches of the lower courses of several European rivers Zeuner (1945) came to the conclusion that phases of low sea level, characteristic of glacial periods, separated more than one, and probably all, of the above interglacial high terraces.

The astronomical theories of Milankovitch (1930, 1938) on the fluctuations of solar radiation due to perturbations of the earth's orbit, as reapplied by Zeuner, gave him an explanation for the remarkable alternations of glacial and interglacial climate characteristic of the Pleistocene.

Spitaler (1939) obtained some different results for the variations of solar radiation, after some earlier calculations of his had been disputed by Milankovitch (1938 (2), p. 639). Zeuner named several mathematicians who supported the Milankovitch calculations and using this data attempted an absolute chronology for the Pleistocene period. Whether Zeuner's absolute chronology will, in detail, stand test is not certain; the principal outlines seem consistent with conclusions of several independent fields of geological study.

Allowing for differences in detail it would appear now to be tolerably certain

that during Pleistocene time periodic lowering of the earth's temperature, through reductions of the amount of solar radiation received, brought about four major glaciations. During these glacial phases large icecaps simultaneously formed at both poles of the earth. Water withdrawn from the oceans as ice was accumulated in the caps. Sea level dropped and low marine terraces, at present lying below sea level, were formed. Between each of these ice ages, each with its glacial "low tide," there was a rise in temperature, and following a period of retardation caused by the absorption of heat in the ice melt (a factor whose time value is not yet fully established) ice caps shrank, releasing water to the ocean; a rise in sea level resulted in an interglacial "high tide." Subject to eustatic modifications of sea level introduced by the sum total of world tectonic activity, and local deformations, the water rose in accordance with the degree of melting to form an interglacial high terrace. Evidence is that present sea level is at some immediate position between such a glacial low and an interglacial high terrace phase. Presumptively there is a present trend towards the last-named phase.

Zeuner (1946) has published a further work on geochronology and its bearing on the development of man. This book had not come to hand in time for use in the preparation of this paper.

Keble (1946) and Keble and Macpherson (1946), in studies of specific terraces at Maribyrnong, and in Port Phillip Bay, summarized recent work in Victoria on the subject of marine terraces, with a bibliography. In the course of discussion Keble (1946, fig. 15) gave a correlation in which were included the two latest high terraces of South Australia, and two late glacial stages in Tasmania. His table, developed in the absence of Zeuner's work, emphasizes the growing strength of evidence upon which the main outline of Pleistocene sequences is beginning to be based. His identifications depart principally from those of Zeuner in the placing of the Woakwine terrace as Würm 2/3 Interglacial, rather than as Riss-Würm Interglacial.

Crocker and B. C. Cotton (1946) studied raised beaches in the Lower South East of South Australia, determining useful faunal associations for several terraces. They observed the identity of suites of terrace shell species with living faunas at other places. They seemed to regard this relationship as of primary significance in determining the age of the terraces. On the possibly weak basis of colour preservation of some shell fossils, the raised beach deposits were considered as of Recent and not Pleistocene age. Their terraces were successive still stands of relatively brief duration on an unstable rising shore. Explanations in terms of tectonic warpings, rather than normal sea- and lake-shore processes, were used in detailing the development of lacustrine successions connected with present and immediate past shores.

The time scale of Crocker and Cotton is of little interest; it has not taken into consideration the data of Lewis, Zeuner and other workers. Post-Pleistocene tectonic movements in the South East, on the scale necessary to produce the effects claimed, would seem to require more direct proof than is offered. Fall to the north, seen in stream channels of East Avenue Range, was interpreted as evidence for tilting of this terrace.

With newly-available survey data, Crocker and Cotton were able to make altitude estimations for several of the earlier terraces. A new reading of 105-110 feet (32-34 metres) for the East Avenue terrace seems to eliminate one of the major discrepancies between the Zeuner and Tindale terrace heights.

Zeuner, 1945.	Crocker and Cotton, 1946.	Tindale, 1933.
Sicilian (260)–325 feet.	Naracoorte Range, 220–250 feet.	Naracoorte Terrace, 250 feet.
Milazzian, 205 feet.	Cave Range, 180–190 feet.	Cave, 200 feet.
Tyrrhenian, 105 feet.	Baker Range, 140–145 feet. East Avenue Range, 105–110 feet.	East Avenue, 150 feet.
Main Monastirian, 60 feet.	West Avenue Range, 85–90 feet.	West Avenue, 90 feet.
	Reedy Creek Range, 70–75 feet.	Reedy, 65 feet.
Late Monastirian, 25 feet.	Woakwine Range, 20–25 feet.	Woakwine, 25 feet.

Since Crocker and Cotton worked without consideration of the work of Lewis and of Zeuner their figures may be held to furnish useful confirmatory data for the identification of terrace levels. Only for the Naracoorte terrace is there now any considerable difference between South Australian and the general evidence for Pleistocene eustatic shorelines on stable foreshores. For this difference an explanation in terms of Late Pliocene-Early Recent epeirogenic movement may be valid, but the discrepancies are so relatively minor and the available survey data so little organized that the apparent differences may be resolved upon further study. The Naracoorte shoreline, marking probably the edge of a vast late Pliocene peneplaned land surface, has so far as it has been examined, revealed a shoreline of complexity sufficient to warrant separate and detailed study.

Beasley (1947) in the course of a field study of the occurrences of black sand seams in South Queensland, is one of the latest Australian writers to discuss eustatic terraces. Between Southport and the New South Wales border the landward margin of the coastal plain marks his "Post-glacial" terrace. It lies on the 25 feet (7·5) metres contour line, as shown on the Commonwealth One Mile Military Map, at a distance inland of approximately five miles. It agrees thus

with the Woakwine terrace of South Australia in situation and elevation. Over a thousand bores and excavation made in search of black sand have yielded detail for observations on the present shoreline. Using the evidence afforded by the normal concentration of these heavy sands by storm waves, in the berm at a height of six to eight feet above "mean sea level," Beasley deduces the following sequence:

Würm glacial	(Sea level at 200 feet below present sea level.)
Post-Pleistocene terrace	25 feet above present sea level.
Mid-Recent	Rapid emergence to 10 feet above sea level.
Present	Slow emergence to present sea level.

The original paper should be consulted for details. These are useful in helping to interpret the detailed history of Post-glacial shorelines and they seem to agree substantially with features reported elsewhere, as, for example, those at Fulham in South Australia (Tindale, 1937), where, superimposed on two generations of old red sandhills, there are lacustrine features dated in Recent time.

The 25 feet terrace is shown by Beasley as Post-Pleistocene, rather than either pre-Würm glacial in accord with Zeuner (1945) or Würm 2/3 Interglacial as according to Keble (1946). If either of the latter datings has merit, it may be that the Beasley 10 foot terrace is the Post-Glacial one. Here have been concentrated the black sands gleaned by wave activity during the Post-Glacial rise of sea level from the −200 feet level. This may well explain the reported absence or dispersal of such sands from the earlier 25 feet (7·5 metre) terrace.

L. A. Cotton (1947), whose Clarke Memorial address has become available since this paper was in draft, surveys the distribution of terrace levels between −600 feet and +600 feet in both stable and unstable areas surrounding the Pacific Ocean. The numbers of terraces appear to increase with instability. Some terraces are of wide lateral extent; these are eustatic; it being unlikely that land movements of the same vertical range could extend over very large areas. Such epeirogenic movements as have been proved are usually accompanied by warping. Despite uncertainties introduced by inaccurate methods of measuring heights in areas not yet critically surveyed, there is marked correspondence in the heights of eustatic terraces.

His summary draws attention to the great available amount of local evidence for terrace formations and, although not directly expressed, his survey points up the importance of further field work in tracing the lateral extensions of the various observed terraces.

PRESENT SHORELINE OF THE SOUTH EAST OF SOUTH AUSTRALIA.

Study of the "Recent or "Present" coastal dunes at many places between the Glenelg and the Murray Rivers yields a wealth of data on the state of maturity of the present shore and indications of the complex local histories of cutting and filling which have culminated in the present shoreline. Ward (1941, p. 10) has indicated the difference in shore patterns between the Coorong dunes and those south of Cape Jaffa.

Johnson (1919, 1938) and von Engeln (1942) have shown that on a shallow coast a drop in sea level brings into play a well-marked series of events and commences a cycle of marine erosion whose normal sequences are well marked. As the sea falls the shoreline moves seaward and a foreland or strand plain is developed at land's edge. Because of the shallow water on such a strand plain the larger erosive waves will break a great distance off-shore and as formation of detritus begins, a submarine bar will appear. At this stage a small notch will mark the landward margin of the strand plain. Eventually the submarine bar will rise above sea level and become a permanent shore bar, comparable with the coastal dunes of the present Coorong. Detritus is added to this off-shore bar; it grows and may at first extend seaward for some distance, dependant on the initial slope of the emergent land surface. Between Kingston and White Hut the dunes are growing in this manner. Behind the bar forms a swamp lagoon, comparable with the Coorong Lagoon and with lakes such as Bonney, George, Eliza. These swamp lagoons will have varied physiographic and faunal histories depending on their access to rivers, their salinity and their possession or lack of outlet to the sea. Gradually they will fill with swamp deposits, as, for example, at Bevilaqua Ford and the Causeway. During the filling processes transverse bars may form in the lagoon and divide an originally continuous lagoon into several smaller ones, as at Lakes Eliza, St. Clair and Bonney. This stage of development is brought to a close by deepening of the foreshore by wave erosion, as at Cape Martin. The foreshore is then attacked and its deposits thrown further and further on to the shore, as on the Coorong near Barker Knoll and at Lake Bonney where wind-blown dune sands transported from the coast are encroaching on the lagoon. In places the dunes may be breached, at first only temporarily, as perhaps indicated by an intercalated marine phase at Lake Bonney, and then permanently, as at Beachport and Robe. Eventually the shore deposits may move so far inland as to overwhelm the swamp lands and lagoons behind the original bar. At this stage or before, the seaward margin of the sand-buried lagoonal deposits, projecting from beneath the mantle of dune deposits, may come under direct attack by the sea, as at the South Australian-Victorian border, and at Blackfellow Caves. With progressive erosion a final stage will appear in which the swamp lands are

eliminated and the latest dunes may pile up on the original shoreline, as perhaps is happening in the vicinity of the mouth of the Glenelg River. At this stage the coast has been brought to grade, and the foreshore will be a relatively deep one.

Factors influencing the rate of development of the various sections of the coast of the South East include the following:

(a) Initial slope of the land and of the continental shelf.

(b) The induration of the sediments subjected to marine erosion.

(c) Aspect of the coast and its orientation to directions from which major currents and storm waves arrive.

(d) Set of coast-wise currents and drying winds determining the resting places of those parts of the products of erosion which are not transported away to deep water.

(e) Rivers, estuaries and their deposits.

All these factors are of importance. As has already been explained, the width of the continental shelf to 100 fathoms varies within wide limits: about 15 miles off Carpenter Rocks, 20 miles off Glenelg River, 25 miles off Rivoli Bay and between 80 and 100 miles off the mid-point of the Coorong.

In general, the stage of maturity reached by the present shoreline of the South East depends on the slope of the continental shelf. Where, as near the Glenelg River, off Blackfellow Caves and at Beachport, it is relatively steep, the shores are in stages of early maturity. Fronting the shallower coastal waters of the Coorong the fore dunes have yet scarcely more than begun to encroach upon the lagoons and shore development is in a more immature stage.

The types of land surface subjected to wave attack in the South East include granitic domes, dolomite beds, hard limestones, soft shelly limestones, silts, sands and flint boulder beds. The flint boulders, derived by erosion from Miocene sediments, form veritable breakwaters on some shores, and may affect materially the rate of erosion. At some places small outcrops of granite have withstood the greatest efforts at levelling made by the sea, although usually on strand plains, present and Pleistocene, they are all but planed off level with the strand itself. Good examples occur at Brown Cattle Creek and Papajara, both in the Hundred of Duffield, and at Lantjin Swamp, Hundred of Landseer.

At the northern end of Lake Bonney there is a typical transverse bar composed of lakeshell detritus, which has cut off a segment of a former larger lake, extending to the north. Immediately to the rear of this beach is a slightly older one with marine and estuarine shells showing that at some recent period Lake Bonney had greater access to the sea than at present.

Evidence at Beachport, where breaching of the Recent dunes by the sea has

exposed sections of the earliest consolidated dunes so far known of the "Present" series, indicates a relatively complex late history.

When these dunes, as exposed at Glen Point and Cape Martin, were being developed an open beach shell fauna prevailed. This comprised dominant *Chione* and some *Brachyodontes erosus*, indicating presence of estuarine conditions. True rock shells such as *Turbo undulatus* were notable for their absence. It is probable that sea level was a few feet higher than at present. These dunes grew seaward and became indurated by calcareous consolidation beneath a red soil horizon. With the dynamic alterations brought about by slow maturing of the shore, perhaps complicated by minor eustatic fluctuations of sea level (such as are estimated to have occurred throughout Post-glacial times), these dunes are now being subjected to active erosion by the sea; they stand up as cliffs 20 feet high, fronting Cape Martin and Penguin Island. Commencement of this stage and consequent exposure of indurated dune rocks is indicated by the appearance of a mixed sand- and rock-shell fauna dominated by *Turbo undulatus*. The "Present" shoreline is, therefore, a composite one with traces of an older, probably Post-glacial phase, only a few feet above present sea level, as well as the present-day dunes.

WOAKWINE TERRACE.

The 25 feet (7·5 metre) Woakwine Terrace has been traced in the field continuously from east of the Glenelg River to Lake Alexandrina on the Murray River, a distance of 230 miles. Its usual position is about three miles inland from the present coastline and its shore deposits and dunes extend inland in more than one line to widths of from three to five miles. Two series are conspicuous, with traces of a third between them. Inland from Robe the two main series of dunes forming part of the Woakwine Terrace are particularly well defined. Locally they are known respectively as the Woakwine and Dairy Ranges. Interdune lagoons forming Lake Hawdon and Woakwine, and Tea Tree Swamp separate the two ranges. The inland Dairy Range dunes in general are lower and more mature than the seaward Woakwine Range. They have a greater overburden of residual quartz sand, derived apparently by release and accumulation of quartz grains after leaching away of the surface of the limestone dunes. In places the interdune swamps between the two suites of dunes have been partly filled in with wind-blown quartz sand derived from the progressive decomposition of range uplands. The shoreline forming the front of the Woakwine Terrace is defined by a continuous consolidated dune "range" which varies from 200 to 100 feet in height, usually rising boldly from a beach which stands at approximately 25 feet (7·5 metres) above L.W.O.S.T., Port Adelaide. Behind it is an older intermediate dune series, unnamed, against which it abuts.

Between the Victorian border and Kingston, and again near the Murray River, many survey datum points made in connection with the drainage of the South East are available. At Glenelg River, vertical sections through the Woakwine Terrace rest on a planed-off Tertiary limestone pavement, approximately 12 feet (3·5 metres) above river level on the front of the dunes and 20 feet (6 metres) on the inner side. Also a stranded meander is cut in Tertiary Polyzoal limestone with a floor 12 feet (3·5 metres) above river level, furnishing useful local evidence for the terrace. From all these indications the elevation of the strand plain upon which the Woakwine Range deposits were laid down can be closely determined as 25 feet(7·5 metres). The innermost Dairy dunes rest on approximately the same level as the Woakwine dunes, as demonstrated by the fact that the inland margin of the Dairy Range lies below 29 feet (9 metres). This is the general level of Biscuit Flat, as determined from many available survey points in the Hundreds of Bray and Bowaka (range, 26·9–32·2 feet).

Sixty miles north in the Hundreds of Duffield and Landseer, to the west of Ten Mile Point (Taratap Station), the surveyed heights show a similar range from 26·5–32·0 feet for the local equivalent of the inner margin of the Dairy Range phase of the Woakwine. Inland from Kingston the Woakwine terrace is not covered by dunes. Limestone beds with *Phasianella* and *Equichlamys bifrons* at Section 448, Hundred of Lacepede, at an altitude of 15 feet (4·5 metres) are evidence that, as in the present Lacepede Bay, a weed-fronted shore existed here on the 25 foot terrace during Woakwine times.

The front of the Woakwine Range has been traced and seen to be continuous from the Hundred of Lacepede to Salt Creek. At the latter place, Salt Creek, which is the continuation of Reedy Creek, cuts across the Woakwine terrace dunes. It seemingly maintained its channel throughout the period of building-up of the Woakwine shore dunes and since the post-Woakwine drop in sea level has partly entrenched itself therein. Details of the physiographic development of this and other stream beds is given under separate heading. North beyond Salt Creek the front of the Woakwine terrace is continuous to Lake Albert. It has been traced on the ground and in part also from the air. A stream mouth may have existed at McGrath Flat. At Lake Albert the details are open to more than one interpretation. The most likely overall explanation is that the latest Woakwine Terrace shore deposits form the seaward shore of Lake Albert and these dunes continue rather directly north-west towards Hindmarsh Island. The earlier phases of the same terrace seem to be represented by the landward shore of Lake Albert and form the peninsula running down to Narrung Point and Pt. McLeay. Lake Albert has its own 25 foot (7·5 metre), lake terrace, as well as a present-day shore terrace. A similar high terrace appears in Lake Alexandrina. This is evident in

aerial photographs taken by the present writer in 1936. It seems the Murray has changed its lower channel more than once. An old stream bed appears to flow through Narrung channel to Lake Albert and thence to the late Woakwine sea. This channel may have been abandoned during the latest phase of Woakwine time. Much of it is preserved near Campbell Park, between Warringee Point and Section 276, Hundred of Malcolm.

Elsewhere in South Australia wherever a search is made in suitable situations, traces of the 25 foot (7·5 metre) terrace can be found with relative ease. Tindale (1937, fig. 11) noted what appears to be the same terrace forming the older red sandhills of Fulham in the Gulf of St. Vincent and this terrace is evident at other places in the gulf, including Port Wakefield. Crocker (1946) describes a raised shoreline at Point Brown at 16 feet (5 metres) above sea level which is possibly the same, although it is more probable that it is the Post-Glacial terrace, since he considers it was laid down when sea level was about 10–12 feet higher than at present. During a coastal car journey in 1938–1939 from north of Cairns in Queensland via New South Wales, Victoria and South Australia to the eastern part of Western Australia, also to Esperance and parts of the coast between King George Sound and Moore River, sufficient evidence was met with to indicate that a terrace at approximately 25 feet is a general characteristic of at least one-half of the shoreline of the Australian continent.

REEDY TERRACE.

The dune range which marks the seaward front of the Reedy Terrace has been traced almost continuously, in the field, from east of the Glenelg River in Victoria to north of Brown Cattle Creek in County Cardwell, a distance of about 150 miles.

In the Hundred of Symon the front of the range is 12 miles from the present sea shore; further north in the Hundred of Landseer the distance is about six miles.

The landward edge of the strand plain fronting this terrace can be identified at many places, between the Hundreds of Mt. Muirhead and Landseer, over a distance of about 75 miles, and its altitude determined rather accurately from drainage survey points, as 45 feet (range, 44·5–46·7 feet). This strand plain gives evidence of having been a relatively mature wave-cut terrace from three to four miles wide, rising with remarkably even grade from the inland side of the later-formed Woakwine terrace dunes.

The sea floor deposit strewn surface of this strand plain is so level that when travelling upon its open surface, the distance melts into a wide mirage with the Woakwine and Reedy Creek dune ranges rising up on each side of it like hills. North of Comung the front of the terrace is so pronounced a feature that its

position and trend has determined roads and survey layout of the country for a north-south distance of over 100 miles; only to the south where more extensive solution of limestone dunes has taken place has quartz sand drift been a determining factor in causing roads, etc , to be placed a little away from the actual front of the terrace. The exact correspondence of terrace height over such distances probably precludes the terrace being due to any epeirogenic movement of uplift.

Reedy Terrace, between the Hundred of Kennion and the Hundred of Murrabinna, over a distance of 50 miles, is cut obliquely by the Reedy Creek stream bed, the coast-side dunes being known as the Reedy Creek Range, the inland dunes as the West Avenue Range. North of the Hundred of Murrabinna the two "ranges" become one, being separated only by minor interdune swamps representing former drainage channels. The inland side of West Avenue Range preserves, in solid limestone covered by a veneer of quartz sand, many features characteristic of the Bevilaqua Ford area behind the "Present " dunes near Rivoli Bay. At such places as Avenue Plains, Mt. Scott and Smith Swamp it is difficult to realize that one is not near the ocean. The height on the Reedy Terrace at which were laid down the earliest dunes forming West Avenue Range, can be determined as greater than 70 feet, but probably no higher than 90 feet.

Since the front of Reedy Creek Range is a relatively mature wave-cut notch, the actual terrace height is greater than the 45 feet registered by the floor of its foreshore. To assist in determining the height of the actual terrace the following data is available. It will be observed that the floor of Reedy Creek in the Hundred of Murrabinna, just before it breaks through the Reedy Creek Range at Blackford, varies from 58–61 feet. This may determine that the principal series of Reedy dunes were laid down at a height of approximately 65 feet (19·5 metres) above present sea level (L.W.O.S.T., Port Adelaide).

Present difficulties in accurately determining the height of Reedy Terrace are due to the physiographic evolution which has gone on since the terrace was formed and to lack of accurate survey height data, excepting for old stream beds, on the inland side of West Avenue Range. These channels, which come together in County Cardwell to pass through the Reedy Creek Range as Brown Cattle Creek, are mature streams and have lowered their beds below the former height of the terrace, so that, for example, between Avenue Plains Station and the southern boundary of County Cardwell (a distance of 40 miles) there is now a regular fall from the 78 to the 59 foot mark (6 inches per mile). At Mt. Bruce the floor of Avenue Creek is at 89 feet, while a few miles further south, Reedy Creek at Kennion, stands at 94 feet as it flows through West Avenue Range in a channel now choked with its own debris.

Formerly Reedy Creek flowed into the sea near Hatherleigh; there is in that

vicinity evidence suggesting its diversion northward during late Reedy Terrace times. The presence of lacustrine and estuarine deposits near Hatherleigh connected with its former channels has, over a distance of about 25 miles, introduced complexities in the physiography deserving of special study.

According to a very tentative interpretation, the front of Reedy Terrace can be linked with Hatherleigh and Millicent Ranges and also forms the old sea shore evident at Tantanoola (elevation, approximately 80 feet). According to this view, Millicent North stands on a line of dunes between two swamp areas. This line of dunes is a transverse beach ridge developed at the northern end of Wyrie swamp at a time when it formed part of the lagoon behind the Woakwine Terrace dunes. The altitudes of the strand plain of Wyrie swamp, 55 feet (17 metres), and of Mt. Muirhead Flat, behind this terrace front (60 feet), may be held to support this interpretation. Further south, evidence of what is apparently the earliest phase of Reedy Terrace is found on the plain near the foot of Mt. Burr Range. At Section 225, Hundred of Hindmarsh, it is a marine terrace, cut in Miocene limestone and strewn with tabular flint boulders and marine shells *in situ* at an elevation of 80 feet (25 metres). This height was estimated by R. A. Keble and the present writer, using aneroid readings tied to a drainage survey datum of 62 feet at Snuggery. The same marine floor appears near the foot of Tantanoola Cave scarp on the inland side of dunes. Also identified with an early stage in the formation of this terrace, at an altitude of 90 feet (28 metres), read by aneroid and tied to the railway survey datum at Tantanoola Station, 83 feet (26 metres) is a flint boulder beach *in situ*, covered by dunes, the sands of which rise to heights up to 115 feet in a belt about a mile in width. The seaward face of the terrace is a broad plain 80 feet (25 metres) above sea level, which drops rather suddenly down, west of Snuggery, to the level of Wyrie Swamp at 55 feet (17 metres).

An interpretation contrary to the above, unpublished, regards Millicent Range, in the vicinity of Millicent, as the inland margin of the Woakwine Terrace, with the rest of which it links up by way of the uplands of Millicent North. Acceptance of this view would seemingly mean that the earliest Woakwine Terrace floor and dunes were locally elevated approximately 30 feet. Since the front of the Woakwine Range stands here at the same height (25 feet) as elsewhere, this uplift must have been completed and its effects on the local shoreline largely removed before the end of Woakwine Terrace time. This suggested local disturbance, if it be real, does not appear to have affected general terrace relationships in the Mt. Schank areas and elsewhere to the south as far as the Glenelg River.

Attempts have been made to trace Reedy Terrace northward to the Murray River. Beyond County Cardwell a terrace occurs and has been observed inland

from Salt Creek, behind McGrath Flat, and inland from Meningie. At these places it appears to stand in the same general relationship to the Woakwine Terrace, as does the Reedy Range further south; survey data as to altitude is not available. What seems to be the same terrace has been identified again between Wellington and Tailem Bend on the River Murray, where accurate height data

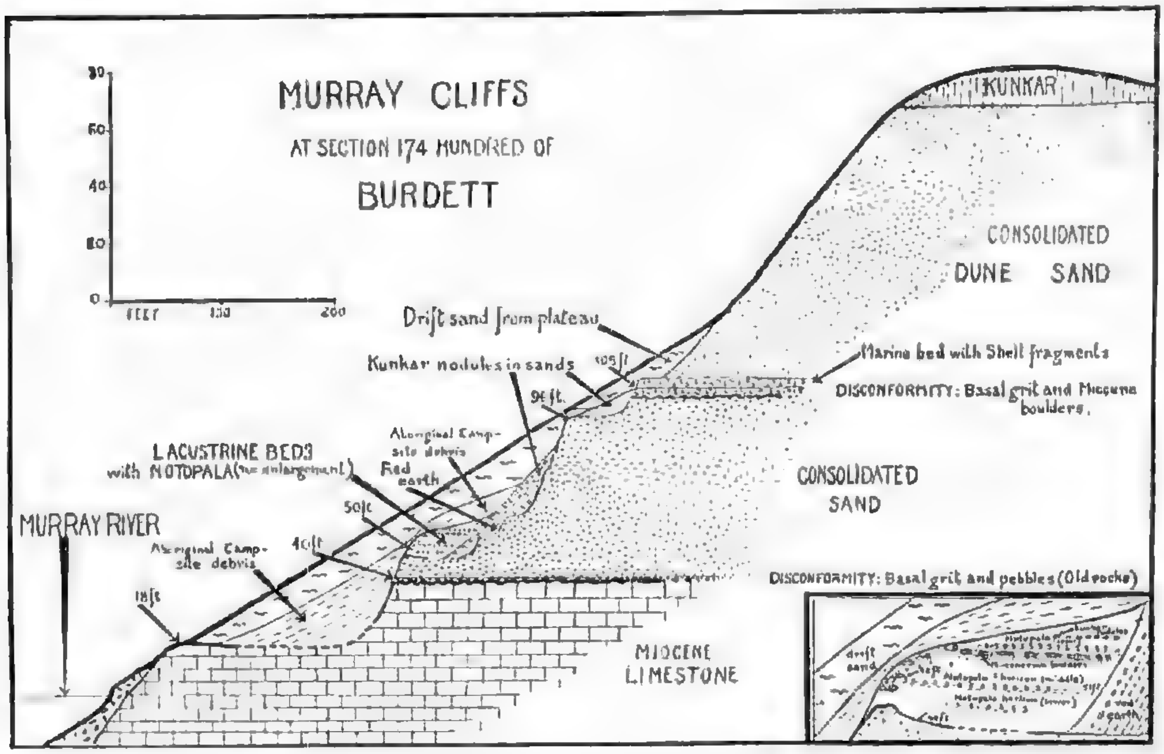

Fig. 1. Murray Cliffs at Section 174, Hundred of Burdett.

is available. A measured section of beds at Section 174, Hundred of Burdett (fig. 1) provides a useful starting point for discussion. From this series of beds a subfossil shell, *Notopala wanjakalda* of the family Viviparidae, was described by B. C. Cotton (1935). This shell is a peculiarly ribbed form related to *Paludina* and is thought to be one characteristic of Pleistocene lacustrine beds. Similar ribbed *Vivipara* have been found by Fuchs (1936) in the Pleistocene of Lake Edward, Uganda. The heights of the freshwater beds from which the shells came, having been incorrectly stated in the original description, the bed was surveyed down to local river level by P. S. Hossfeld, T. D. Campbell, F. Fenner, B. C. Cotton and the writer in February, 1936; the results are shown in the present section. In the figure the heights above 53 feet were determined by aneroid readings and, therefore, may be less accurate than in the measured part of the section.

The section shows a lacustrine bed associated with the present Murray Valley, at a general height of 50 feet (15 metres) above local river level. The

thickness of the lacustrine bed is just under 10 feet (3 metres). Prior to the locking of the Murray mouth the river locally was subject to a slight tidal flow. Its normal height at Murray Bridge has been estimated as approximately 5 to 7 feet above sea level. The lacustrine bed, therefore, very clearly corresponds with the general height of the latest phase of Reedy Terrace, 65 feet (19·5 metres), as determined over 100 miles to the south. If this correlation can be accepted, some further data may be considered to support it. When traced downstream from Murray Bridge a terrace can be followed at the general height of the Burdett 50 feet (15 metre) terrace. It runs out into the air on the plateau at Tailem Bend (elevation by railway survey, 60 feet (18 metres) at Tailem Bend.

This plateau can be interpreted as the strand plain with associated shoreface deposits of the Reedy Terrace. Between Tailem Bend and Burdett, the Murray has cut through false-bedded dune deposits composed of consolidated sands which are of Post-Pliocene age and which appear to represent shore dunes of a marine terrace behind which the *Notopala* lagoon may have been formed.

In March, 1933, with C. Fenner the present writer examined the left bank of the Murray at Section 339, Hundred of Seymour, one mile downstream from Tailem Bend.

SECTION 339, HUNDRED OF SEYMOUR.

Elevation above river.	Description of bed.	Identification.
55–60 feet	Kunkar with superficial soil on top of plateau	
48–55 feet	Clay	
40–48 feet	Littoral bed (D)	Pleistocene
35–40 feet	Littoral Marine to Estuarine (C)	Werrikooian
10–35 feet	Green and mottled clay	
6–10 feet	Arenaceous limestones with marine shells (B)	Miocene
0–6 feet	Limestone with marine shells (A)	Miocene

Specimens from four of the principal beds were submitted to the late Frederick Chapman whose identifications were:

Bed "A." Pale cream-coloured foraminiferal limestone, rather friable. Included are fragments of cherty material of a grey colour including foraminifera and polyzoa. Washings contain foraminifera (*Textularia gibbosa, Cassidulina subglobosa, Guttulina communis, Anomalina ammonoides*), ostracoda, *Cytherella lata* and echinoid spines.

Bed "B." Fine-grained, cream-coloured limestone, moderately friable, with a few glauconite grains, siliceous and calcareous sponge spicules and brachiopoda (*Magellania* cf. *insolita*). Washings contain foraminifera (*Anomalina ammonoides, Cibicides mundulus*).

Bed "C." Cream to pale-ochreous-coloured limestone containing littoral marine shells (*Macrocallista* sp., *Turritella* sp. and *Chione striatissma*). Matrix resembles a consolidated shore sand and dune rock.

Bed "D." Mottled cream-coloured travertine or freshwater limestone, having a brecciated structure. A fractured surface shows apparent negative casts of vegetable cells, also traces of casts and moulds of ? fresh-water molluscan shells.

"The more or less recent aspect of the fossils in "C," especially in the occurrence of *Chione striatissma*, point to a Werrikooian (Upper Pliocene) age. "D" is undoubtedly of Pleistocene age, as it agrees in structure and organic contents with similar deposits in the district."

This determination suggests that the shore deposits characterizing the vicinity of Tailem Bend, on the postulated Reedy Terrace may be Pleistocene in age.

Half a mile upstream, at Section 340, Hundred of Seymour, the cliff displays a section of sediments within the Murray Valley itself with marine beds of Miocene age planed off at a level of 20 feet (6 metres) above the water, covered by estuarine deposits and clay. There is a kunkar horizon at 33 feet (10 metres) followed by clay beds to 47 feet (14 metres) above which, to the local level of the bank at 50 feet (15 metres) is soft and hard kunkar, and a thin layer of sandy soil. Allowing for local river level, the disconformity at 20 feet (6 metres) seems to belong to the Woakwine Terrace which followed Reedy Terrace.

EAST AVENUE TERRACE.

The East Avenue Terrace comprises a large series of dunes and swales of which the later ones fall together as East Avenue Range, while earlier ones are grouped as Baker Range.

The East Avenue Range series is usually three to five miles wide while Baker Range dunes vary in width from about seven to ten miles.

The double series of dunes identified as the shore deposits of this terrace form a belt ten to fourteen miles wide; far greater than on any other terrace. It may imply a relatively long period during which dune deposits were being built up on the terrace. This may be a significant pointer when correlation with terraces elsewhere is under consideration.

The front of the terrace lies between fifteen and thirty miles inland from the present coastline. It has been traced in the field continuously from just north of the northern boundary of the Hundred of Landseer to a point eight miles south

of Crower, a distance of 60 miles. In this distance it maintains a remarkable uniform appearance, rising rather gently from the shore platform. The shore platform itself gives evidence of having been a relatively immature one when the sea retired at the onset of post-East Avenue emergence. There are traces of what may have been an abandoned bar on the foreshore, or a lagoon shore. This locally, is called a "mid-bank."

Originally the general level of East Avenue Terrace was estimated to be 150 feet (46) metres above sea level, this level being based on the estimated altitude of the strandline upon which the Baker Range deposits were laid down. Newly available survey data first quoted by Crocker and Cotton (1946) suggested to them that a lower altitude near 105-110 feet (32-34 metres) might be a more likely mean figure. This would bring about very close correlation with Zeuner's results. Vast changes evidently have taken place since the East Avenue Terrace was formed. In some places quantities of quartz sand have been left on the surface by the leaching away of the lime content of the upper layers of the dunes. At times this quartz sand has been transported by wind, and has in places modified the original configuration and simplicity of the terrain. During periods when sea level was low, stream beds which cross the terrace excavated their channels, causing other modifications. One such stream, passing down through Tatiara Point, Avenue Range Station, and thence north to Wimpinnerit, drew its waters from country inland beyond the terrace. This stream at first flowed west, but was diverted in a northerly direction by the growing dune series. However, it kept its mouth open and passed through the latest shore deposits of the terrace, west of Wimpinnerit, in the Hundred of Peacock. From here onwards the stream is known as Brown Cattle Creek. The bed of this stream between the Tatiara Point and its place of embouchure on to East Avenue foreshore near Wimpinnerit drops from 91 feet (28 metres) above sea level down to 63 feet (19 metres) in a distance of 35 miles (9 inches per mile).

At the crossing of the Kingston-Naracoorte railway over the present Bakers Range excavated drain, the level of the plateau is 109 feet (34 metres). The lowest reading between Baker and Avenue Range near the northern boundary of the Hundred of Fox is 108 feet (33 metres). Away from major watercourses, as in the north-western area of the Hundred of Short a low reading lies at 119 feet (37 metres), while at the south-western corner of the Hundred of Joyce the lowest readings also are at 119 feet. The south-western corner of the Hundred of Lochaber lies at 113 feet (35 metres) With exceptions the available drainage survey data yields information chiefly about mature drainage lines and must, therefore, be interpreted with caution. On the evidence, the Crocker and B. C Cotton estimate of 105–110 feet (32-34 metres) for the terrace is probably as close as can be ascertained at present; but the earliest dunes of the series at the inland

side of Baker Range may have been deposited at a somewhat higher level, not exceeding 150 feet and probably lower than that figure.

Between Crower and the vicinity of Tantanoola the East Avenue Terrace has not been traced in the field. From maps and survey data it appears to continue its north-south trend until it strikes the Mt. Burr Range. In the north-west of the Hundred of Riddoch evidently it is cut through by the waters of both the Reedy and Avenue Creeks, here flowing relatively close together, although their immediately lower courses draw widely apart.

At Mt. Burr Range this year, R. A. Keble and the writer ran two sections, and observed marine platforms, cut in Miocene polyzoal limestone, and strewn with flint boulders, at several elevations, indicating on the seaward front of this range, the presence of more than one terrace earlier than that identified as Reedy Terrace itself. The data obtained is of sufficient interest to warrant further field work, and it may then be separately published. Suffice to say, that at the Collapsed Cave (Section 123, Hundred of Hindmarsh) shore deposits, including a flint boulder beach, were encountered between the limits of 120 and 140 feet (37–43 metres) above sea level (as measured by aneroid from a drainage survey datum of 62 feet at Snuggery). This may represent the local expression of East Avenue Terrace. Higher up on the range at the north-east corner of Section 272, was a marine terrace at 148 feet (44 metres) also cut in Miocene polyzoal limestone, on which were water-laid shore deposits, *in situ*, up to 30 feet (9 metres) in thickness. These contained a typical reef shell association which included *Turbo undulatus, Brachyodontes erosus* and *Nerita*. This could represent the Baker Range phase of the Cave Terrace, but may be older.

In the Murray Valley positive identification of the East Avenue Terrace has not been made. It may be significant that as shown in fig. 1, at Section 174, Hundred of Burdett, there is a disconformity at 105 feet (32 metres) above local river level, with a basal bed containing boulders of Miocene limestone, over-laid by a thin marine bed with shell fragments (not identifiable). This was followed by a thick dune sand series. These may represent the East Avenue Terrace. The close correspondence of the altitude with that suggested for East Avenue Terrace in the South East is worthy of note.

CAVE TERRACE.

Cave Terrace in the South East is a relatively narrow belt of shore deposits one to two miles in width, placed usually only one or two miles inland from the landward side of the earliest East Avenue Terrace deposits.

The limestone dunes of this series have been worn down to relative stumps by erosion and are much consolidated by redeposition of lime. Extensive and complex

cave formations are characteristic and have given rise to the name in the type area south of the Naracoorte-Kingston railway line. Field work on this terrace has been confined chiefly to the vicinity of Stewart Range Railway Station where the dunes rest on a platform whose height is at 160 feet (49 metres) or above. This is the altitude of the present low divide between Mosquito and Naracoorte Creeks on the plain immediately inland from the Cave Range. The area has evidently been subject to some reduction through limestone solution and stream action. The drainage of these streams for the most part escapes subterraneously, although there is evidence of a river channel formerly passing through Cave Range to the north of Carey Swamp; the floor of this swamp is at 137 feet (42 metres).

In the Hundred of Monbulla, further south, better survey data is available and in the absence of all but local stream courses a possibly better idea of the altitude of the terrace can be obtained. The general level of the plain immediately inland from the range varies from 175 to 200 feet (54–62 metres).

From these indications, only the general conclusion can be reached that Cave Terrace lies between 160 feet (49 metres) as a minimum and 200 feet (62 metres) as a maximum. Crocker and B. C. Cotton (1946) read the evidence as indicating 180–190 feet (55–58 metres) for the height of the terrace, whereas the section given by Ward (1941) seems to imply 175 feet (54 metres). It is evident that further survey data is desirable. On the basis of the few drainage levels available there seems to be some indication that this terrace may be locally, or otherwise, tilted down towards the north (to the order of 35 feet in as many miles), but the evidence indicative of stream action, and erosion by cryptoreic drainage, is so clearly indicated and so similar to that seen, to a lesser degree, in later terraces, it suggests the necessity of caution in accepting such a view without further study in the field.

South of the Hundred of Monbulla the foreshore line of Cave Terrace veers to the west and appears to pass towards the front of the Mt. Burr range, as has been indicated by Crocker and B. C. Cotton (1946).

During a recent visit to Tantanoola, R. A. Keble and the writer found the altitude of the floor of the marine cave at Up and Down Rocks (Tindale, 1933), with its Pleistocene mammal fauna, including a giant kangaroo (*Macropus racchus*) and seals (*Arctocephalus*), at 195 feet (60 metres) by aneroid readings. This is a higher altitude estimate than was made previously. It could tie in with Cave Terrace.

No definite evidence for Cave Terrace is as yet indicated in the Murray Valley. A likely place to search would be in the vicinity of Mannum or to the east of that town where the river makes several abrupt changes in course. The Marmon Jabuk Range in the Ninety Mile Desert could be the trace of this or another of the early terraces of the series.

NARACOORTE TERRACE.

Naracoorte Terrace is a prominent physiographic feature of the South East, rising out of a strand plain indistinguishable from the ones nearer to the present coast.

The front of the terrace has been traced in detail from the vicinity of Julia Hill, east of Penola, for just over 65 miles to beyond Padthaway. The present writer knows it in the field for the greater part of this distance, i.e. from the Hundred of Comaum to the vicinity of Morambro Creek. The terrace height is very approximately 250 feet (78 metres). This is the general altitude of the lowest parts of the country immediately to the east of the dune range itself, but these may have been reduced by solution and karst drainage.

Naracoorte terrace deposits consist of a dune series underlain by Miocene and Balcombian (Pliocene) beds which have been attacked laterally by the sea.

The dune ridges appear to extend inland from two to five miles; their inner limit is known to the writer only in the immediate vicinity of Naracoorte.

Naracoorte foreshore was mature and the strand plain suggests that during the sojourn there of the sea it had been brought to grade, so that there was relatively deep water off-shore and the sea was attacking the mainland itself.

The strand plain fronting Naracoorte Terrace rises from a general level somewhere between 160 and 200 feet (49–61 metres) on the inland side of the Cave Terrace to a strand-line at an altitude near 215–220 feet (66–68 metres). This elevation is roughly indicated by the general occurrence of levels of interdune swamps near the front of the range at many places between Penola and Naracoorte. This was the latest level of the terrace; at an earlier stage it may have been higher.

Several streams pass through the Naracoorte Range. Morambro, Naracoorte and Mosquito Creeks each successfully maintained an open channel through the shore deposits of Naracoorte Terrace. They are consequent streams and in flowing off the old Upper Pliocene peneplain, in their upper courses, have cut down into Pliocene and Miocene beds.

The extension of Naracoorte Terrace northward through the Ninety Mile Desert is not yet traced. Marmon Jabuk Range may be its continuation; however, on available evidence this range equally might be the equivalent either of the Cave or the East Avenue Terrace. Field work and altitude data are required.

In the Murray Valley, Tindale (1933, fig. 5) gave a section at Fromm Landing, Hundred of Ridley, showing a Post-Pliocene thick (30 feet) arenaceous dune-limestone, with marine shells, at an elevation of 200 feet (61 metres) by aneroid readings, above local river level. This would approximate to a terrace height between 210–250 feet (65–78 metres) above present sea level and so could be the local equivalent of the front of the Naracoorte Terrace.

RIVER SYSTEMS OF THE SOUTH EAST OF SOUTH AUSTRALIA.

As indicated by Tindale (1933) the predominantly underground drainage of this low level karst area has been an important factor in the preservation of the relatively youthful appearance of the dune ranges which serve as convenient markers for the eustatic marine terraces. River drainage systems were always present and able to maintain a limited regime. Their flow was perhaps only great when subterranean capacity was overloaded and during the readjustment periods after changes of sea level had occurred. The courses of the streams when traced on the map reveal several interesting details:

(a) The streams were antecedent to the formation of the dune ranges.

(b) Their headwaters are mature streams of the old Pliocene peneplaned land surface east of Naracoorte.

(c) During times when the terrace dunes were forming the stream mouths were often diverted along the coast by the formation of off-shore and river mouth bars.

(d) Normal trend of movement when diverted was northward.

(e) Traces of drowned valleys of several streams can be detected running across the ancient Murray Gulf shelf to the continental margin. When more detailed bathymetric contour maps are available study of these valleys may yield important altitude data on submerged terraces.

The principal streams of the area under consideration, other than the Glenelg and Murray Rivers, are the Reedy, Brown Cattle and Avenue Creeks. There are smaller ones south of Millicent with outlets to Lake Bonney. These streams are fed partly by excess of underground water and flow above ground chiefly during the wet winter season.

For present purpose it is convenient to trace the history of several of these streams during East Avenue and Reedy Terrace times and then to tie their courses in with streams further inland and those nearer the present seashore.

During the early part of Reedy Terrace time, Reedy Creeek flowed into the sea at a joint just east of Hatherleigh. Its waters passed across the continental shelf off Cape Buffon. Shortly afterwards this mouth began to be barred and its flow diverted, step-by-step northwards behind developing fore dunes of Reedy Terrace.

It is possible that this northward trend of movement of stream channels is characteristic of periods of building up of foreshore deposits in the South East. Be that as it may, Reedy Creek mouth at the end of Reedy Terrace time came to be at Blackford, after a step-by-step northerly migration of 50 miles. When this is understood it is clear that Reedy Creek Range and West Avenue Range are parts of a single dune series cut obliquely by the stream bed. Zeuner (1945) was

correct in interpreting them as representing a single terrace unit, although he did so on entirely different grounds.

During the retreat phase of the sea which followed Reedy Terrace times, the stream appears to have flowed out across what is now the sea floor of Lacepede Bay in a valley which conveniently may be known as Lacepede channel.

Still later, soon after the beginning of the earliest of the Woakwine Terrace dune formations, Reedy Creek was cut off from direct access to the sea at Blackford and once more began to be diverted, step-by-step northwards behind the developing Woakwine shore dunes. For a period it seems to have maintained a channel open to the sea west of Taratap Station at about the northern end of Section 11, Hundred of Duffield. Diversion again became effective and the stream mouth shifted to near Coolatoo where it became joined with Brown Cattle Creek. Its mouth was maintained there for what may have been a long period of time. The stream bed seemingly can be traced out to sea as Coolatoo channel. Yet again diversion began and by the end of the complex events of Woakwine times its mouth came to be at Salt Creek, 40 miles north of its position at the end of Reedy Terrace times.

Brown Cattle Creek, prior to late Woakwine times, had been an independent stream. It had, throughout Reedy Terrace time maintained a channel through the early and late dunes of the terrace at the northern end of the Hundreds of Duffield and Landseer, locally cutting its bed down to porphyritic granite bedrock on the northern boundary of Duffield. It drew its head waters from the Naracoorte area.

Following the end of Woakwine Terrace times, the combined waters of Reedy and Brown Cattle stream beds apparently flowed out towards a low level seashore by a channel indicated off-shore between Salt Creek and Chinaman Well. This Chinaman Channel can be traced out on the continental shelf for at least 60 miles.

The temporary stabilizations of Reedy Creek mouths at Hatherleigh, Blackford, Taratap and Coolatoo, etc., furnishes probable indications of the interpolation of a temporary low sea level phase at each of these times.

It seems clear that the step-by-step northward diversion of Reedy Creek cannot be regarded as due to small intermittent tectonic tilting movements, but was initiated by the trend of local shore currents. The reality of this has been demonstrated by the experiences of the engineers of the South Eastern Drainage Board. In recent years in their endeavours to maintain the mouth of the present drainage channel of Lake Bonney, they have met with diversionary activities by shore currents, with this difference that at present the shore currents off Lake Bonney South are diverting the mouth southwards. Similarly, the present Murray mouth is moving southward.

It is of some interest to note that the traces of submarine channels on the floor

of the continental shelf seem to indicate by their directions, that the systematic diversions of stream channels may have been continued far out on to the shelf during periods of lowered sea level.

During the whole period while Reedy Creek mouth was moving northward 50 miles between the Hundred of Kennion (inland from Hatherleigh) and Blackford, Brown Cattle Creek seems to have maintained its mouth in a relatively fixed position. Its meandering channel through the "range" shows a rather mature valley with a terrace which runs out into the air on the foreshore of Reedy Terrace. Deepening of the channel in Post-Reedy times has been limited by the granitic stream bottom over which it flows.

Data on the headwaters of Reedy and Brown Cattle Creeks is not yet fully marshalled. Traced inland these two waterways between them seem to have links with most of the streams coming off the old land surface to the east. However, the greater part of the drainage west of Naracoorte and Penola is now subterraneously established and it is difficult to be sure of some of the former connections.

West of Naracoorte several streams flow out into lagoons and lakes. In understanding the formation of these lakes (e.g. Lake Roy, Bool Lagoon and Carey Swamp) an important factor which must not be overlooked is that of the level of the water table. This is always the base level of the cycle of karst drainage development. Thus during periods of low sea level there was an activation of the underground drainage processes and at the same time an increase of relief. In periods of rising sea level, the drainage basins became drowned and appeared as lakes. On the general thesis of a Post-glacial rise of sea level the latest history of these drainage basins is one of lake formation and growth concurrently with the rise in watertable.

EVIDENCE FOR SUBMERGED TERRACES OFF THE COAST OF THE SOUTH EAST OF SOUTH AUSTRALIA.

Admiralty chart, No. 1,014, Cape Jervis to Rivoli Bay, shows the continental shelf of the South East of South Australia with bathymetric data only sufficient to hint at locations and numbers of possible submerged terraces upon its slope.

It seems clear that such low level terraces have existed, for there are indications that at different times during the history of Reedy Creek it has occupied different river channels extending across the continental shelf, for example, south of Cape Buffon out from Lacepede Bay, out from Coolatoo and out from Chinaman Well. Since the approximate times at which each of these different channels was in use can be determined, evidence of the limits to which each successive channel can be traced on the continental shelf might be expected to indicate the order of succession of low level terraces.

The generalized contours which can be drawn on the present charts, unfor-fortunately are insufficient to give more than a few clues. The position also is complicated by the fact that Coolatoo channel was probably occupied by the Brown Cattle stream bed on more than one occasion before it and its captured tributary, Reedy Creek, became diverted to Salt Creek and thence out towards Chinaman Channel.

Channel.	Mouth.	Period of utilization by Reedy Creek.	Some terrace traces on continental shelf.
Buffon	Hatherleigh	Pre-Reedy Terrace Low	–170 feet
Lacepede	Blackford	Post-Reedy Terrace Low	–120, –170 feet
? Lacepede	Taratap	Interval within Woakwine Terrace	
Coolatoo	Coolatoo	Interval of Woakwine Terrace	–60, –120, –170, –200 feet
Chinaman	Salt Creek	Post-Woakwine Low	–120, –170, –200 feet

From the above tentative indications the Post-East Avenue Terrace could have been at about 170 feet (–50 metres) and a Post-Woakwine low may have been at about –200 feet (–60 metres). More detailed bathymetric data is needed before the situation can be clarified.

There are low-terrace deposits within the active zone of beach erosion off the present shore. Flat slabs of limestone are washed ashore on the present beach of the Coorong. One such slab of muddy limestone collected near Barker Knoll contained a shell fauna in which the dominant is a small species of *Venerupis*, either not now living or rare off the shore.

SUBDIVISION OF PLEISTOCENE TIME IN SOUTH AUSTRALIA.

In the previous paragraphs data has been brought together to enable an attempt to be made at subdividing the Pleistocene.

This data together with that of Lewis (1945) and Keble (1946) permits an attempt to consider the Tasmanian Pleistocene glaciations in relation to the inter-glacial terraces of South Australia, and thus to prepare a preliminary correlation of the South Australian Pleistocene.

Likely starting points for such a correlation appear to be either an identifica-tion between the Millbrook Rise Stage of Lewis (1945), and the Milazzian inter-glacial, of Zeuner (1945), or a correlation between the "longest interglacial of Tasmania" (Pre-Yolande), the Tyrrhenian (or Great) Interglacial, and East Avenue Terrace, greatest of the strand series in South Australia.

Millbrook sediments fill the lower troughs of Malanna glacial valleys to a height of 150 feet (45 metres) above present sea level. Were Tasmania an

entirely stable land mass in Pleistocene time this height would be sufficiently close to that of the Milazzian Terrace to give a significant correlation. Lewis claims an active tectonic rise of the Tasmanian land mass as well as foundering of the adjacent coasts, during his Millbrook Rise. He does stress the general horizontality of both the "pre-glacial" terrace of his Launceston Stage, and of the Millbrook Rise, thus giving slight support for a possibility that the Millbrook Rise Terrace was substantially of eustatic rather than tectonic origin. Identification of the Malanna glacial as pre-Milazzian and, therefore, probably to be correlated with the Early (Günz) glaciation might be attractive, particularly since Lewis seems positive that the Malannan glacial low terrace was the first such low sea level episode evident in Tasmania. However, this identification at once introduces difficulties which are largely resolved only when the second possible correlation outlined above is examined.

Between the beginning of the Millbrook Stage and the onset of the first phase of the double Yolande glacial, Lewis placed the "longest of the Tasmanian interglacial periods." This at once suggests a link with the Tyrrhenian, by far the longest and greatest of the interglacials of the Mediterranean area and elsewhere. If this datum were accepted it would at once tie in with the East Avenue Interglacial of South Australia, which may have been of great duration, as indicated by the extensive series of littoral sediments, in alternate dune and swale up to fourteen miles wile, constituting the largest series of such sediments left stranded on any interglacial terrace of the South East of South Australia.

According to this identification the Malanna Glacial might seem to correlate with the Mindel (Antepenultimate) glacial stage rather than with the Günz (Early) glacial, unless as is possible, Mindel was only a relatively weak stage in Tasmania. In the latter case, traces could either have been masked by erosion and later glaciations, or might merely await identification.

It will be noticed that the suggested height of 150 feet (45 metres) for the Millbrook Stage terrace would match about as well with the Tyrrhenian (105 feet) as it would with the Milazzian terrace (195 feet). Tectonic movements suggested by Lewis could be utilized to explain the difference unless there was in fact an earlier phase of the Tyrrhenian nearer the 150 feet mark, as seems to be implied by the existence of the Baker phase of East Avenue Terrace in South Australia.

Accepting for the moment the identification:

Tyrrhenian=Millbrook Stage=East Avenue Terrace; later glacial stages appear to fall rather readily into place.

Thus:

Yolande 1=Riss (Penultimate Glaciation, Phase I).
Yolande 2=Riss (Penultimate Glaciation, Phase II).
Margaret=Würm (Last Glaciation, Phases I–III).

At first sight the Ralph Bay Stage beaches (of Lewis) by their universality appear to correlate well with the Late Monastirian=Woakwine Terrace of South Australia, but leave unaccounted for the Main Monastirian, average height 60 feet (18 metres), unless it is of this terrace Lewis (1945 p. 50) is speaking when he says, "Ralph's Bay Stage raised beaches are often 30 feet high, but exposures are not sufficiently frequent to determine the maximum thickness." Here, evidence for north-west Tasmania, furnished by Edwards (1941), may resolve the difficulty, in that he identifies a 40-50 foot (12-15 metre) terrace with Keble (1946) has equated with Riss-Würm Interglacial=Main Monastirian of Zeuner (1945). The Terrace height as stated is lower by two metres than the average for the Main Monastirian, but this may be partly accounted for by differences in method of estimating sea level. Lewis apparently used high tide mark rather than either L.W.O.S.T., or mean sea level. In Tasmania the tidal difference is of the order of 4 feet (1·2 metres).

Rocky Cape Cave (*antea* p. 622) provides confirmatory evidence to suggest that it is the Main Monastirian terrace which is to be found in north-west Tasmania by indicating marine erosion at minimum heights of 50-60 feet (15-18 metres) above present sea level.

The principal problem in the correlation of the latest portion of the Pleistocene is in the position to be assigned to the Late Monastirian (25 feet) terrace. Zeuner (1945, p. 250, fig. 76) placed this terrace between his Penultimate and Late Glacials, i.e. as Riss/Würm Interglacial. Earlier he had placed it as Würm 2/3 Interglacial. Argument for the earlier dating, on face value, is convincing. However, it is necessary for him to depart from the implications of his "Altitude/time" hypothesis to achieve the earlier placing, which may create more problems than it solves. The South Australian evidence as to the detailed history of the Woakwine interglacial terrace may be a help in the unravelling of the complexities of this problem, which assumes great significance because of the implications it has for the interpretation of an important period in the expansion of man's *oekomene*. Keble (1946) arrived at a late dating for this terrace, and in personal correspondence T. T. Paterson also intimates his leaning towards a late dating for Monastirian II.

The indications now available that the Post-glacial terrace at 10 feet (3 metres) is probably distinct from the Woakwine Terrace, 25 feet (7·5 metres), and is represented by an early series of dunes within the complex of "Present" dunes is an advance whose implications for the archaeology of the Australian aboriginal will be considered elsewhere.

An outline of the subdivision of Pleistocene time is set out in the accompanying table:

SUBDIVISION OF

Chronology (after Zeuner)	Named Stages (Northern Hemisphere).	Altitude.	Equivalent Southern Hemisphere Stages.	Altitude.
825,000 to 660,000	SICILIAN Preglacial	260 to 325 ft. (80 to 100 metres)	NARACOORTE Preglacial	Approx. 250 ft. (78 metres)
590,000 550,000	GUNZ (Early) Glacial Phase I Phase II			
500,000	MILAZZIAN Interglacial	195 ft. (60 metres)	CAVE Interglacial	160 to 200 ft. (49 to 62 metres)
476,000 435,000	MINDEL (Antepenultimate) Glacial Phase I Phase II		MALANNA Glacial	
425,000 to 250,000	TYRRHENIAN Interglacial (Great or Long Interglacial)	105 ft. (32 metres)	EAST AVENUE Interglacial	105 to 110 ft. (32 to 34 metres)
235,000	RISS (Penultimate) Glacial Phase I		YOLANDE Glacial Phase I	
188,000	Phase II	(–200 metres)	Phase II	
150,000	MONASTIRIAN I Interglacial (Main Monastirian) Coldphase (not named)	60 ft. (18 metres)	REEDY Interglacial	65 ft. (19·5 metres)
125,000	(MONASTIRIAN II Position according to Zeuner 1945.)			
115,000	WÜRM (Last) Glacial Phase I (Würm 1)	–325 ft. (–100 metres)	MARGARET Glacial	29 ft. (9 metres)
	Würm 1/2 Interglacial		WOAKWINE Interglacial I	
72,000	Phase II (Würm 2)	?–230 ft. (?–70 metres)	MARGARET Glacial	25 ft. (7.5 metres)
65,000	Würm 2/3 Interglacial (Monastirian II alternative position)	25 ft. (7·5 metres)	WOAKWINE Interglacial II	
23,000	Phase III (Würm 3)		MARGARET Glacial	
	POST GLACIAL		EARLY RECENT	10 ft. (3 metres)
0	PRESENT		PRESENT	0

THE PLEISTOCENE.

South Australian Stages.	Altitude.	Tasmanian (Lewis and Edwards)	Altitude.
NARACOORTE Terrace			
		Prebasaltic low Terrace (Edwards)	
CAVE Terrace		Launceston Stage (*Nothofagus* and *Eucalyptus* mild phase)	
		MALANNA Ice Forth Valley formed (Edwards)	Below –150 ft. (–45 metres)
EAST AVENUE Terrace Baker Range Stage East Avenue Stage	Under 150 ft. (45 metres) 105 to 110 ft. (32 to 34 metres)	Millbrook Rise Stage (Longest interglacial of Lewis) (Mindel/Riss interglacial of Edwards)	150 ft. (45 metres) 100 ft. (31 metres)
(? West Avenue Range Stage) (? Hatherleigh Phase)	70 to 90 ft. (22 to 28 metres)	YOLANDE Ice Yolande Phase I Interglacial interval Yolande Phase II	–120 to –150 ft. (–37 to –45 metres)
REEDY Terrace Blackford Phase	65 ft. (19·5 metres)	Rocky Cape Phase	50 to 60 ft. (15 to 18 metres)
Taratap Phase WOAKWINE Terrace Dairy Range Stage Coolatoo Phase Woakwine Range Stage	29 ft. (9 metres) 25 ft. (7·5 metres)	MARGARET Ice (? Ralph Bay terrace, part)	19 ft. (6 metres)
Early Recent Stage Present Shore Stage	5 to 10 ft. (1·5 to 3 metres) 0	Post Glacial Terrace (Edwards) Present Shore Stage	5 to 15 ft. (1·5 to 4·5 metres)

ACKNOWLEDGMENTS.

Much of the data in this paper has been gathered on some fourteen visits to the South East and the Murray Basin between 1930 and 1947, with a total duration of approximately 150 days in the field. With Taratap Station as his usual base the various South Eastern terraces were examined by the author as far to the north-east as Jip Jip Rocks, and south to beyond the Glenelg River, different parts of the country being transversed on foot, in the saddle, by buggy, by car and by sand climbing tractor. For assistance and transport the writer is indebted in particular to Messrs. Tapfield, of Taratap, and especially to the late W. F. Tapfield, who from lifelong experience in the area, assisted in tracing the terraces and watercourses in the field and provided background data of immeasureable value.

For company in the field trips and for inspiration which comes from discussions he is indebted to the following: T. D. Campbell, D. A. Casey, H. Condon, B. C. Cotton, C. Fenner, F. Fenner, H. K. Fry, H. M. Hale, P. S. Hossfield, R. A. Keble, the late A. N. Lewis, A. Meston and S. Mitchell. The author is indebted also to various landowners, among them Messrs. A. Kelly, C. J. D. Smith, W. and M. Tapfield, and G. Barnett for guidance and direction in the pursuance of his field studies.

In February, 1936, Dr. S. M. L. Dunstone piloted a plane in a pre-dawn flight so that the author could examine and photograph specific dune terraces by the oblique light of the rising sun, this flight being made possible by the interest of Sir E. T. Barr Smith in the project. Advertiser Newspapers Ltd., shortly afterwards, provided another plane and cameras to enable further critical areas to be observed and photographed from the air by Darian Smith and the author.

Some of the critical areas on the north-west coast of Tasmania, including Rocky Cape Cave, were visited in March, 1936, in company with Messrs. J. Pearson and A. L. Meston, furnishing a general background for interpretations made in this paper.

In 1936, and again in 1944–1945, visits were made to areas in coastal Maryland, Virginia, and to North Carolina to gain comparative data on the terraces of the south-eastern United States.

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SOME TERTIARY FOSSIL MOLLUSCS FROM THE ADELAIDEAN STAGE (PLIOCENE) OF SOUTH AUSTRALIA

By Bernard C. Cotton, Conchologist, South Australian Museum

Summary

While working out the macrofauna of numerous water bores sunk in the Adelaide Plains by the Mines Department, for agricultural purposes and to provide water for pumping into the mains, a number of interesting molluscs were discovered. A few of these are described here; also some Abattoirs bore specimens selected by Sir Joseph Verco and myself from material donated to the South Australian Museum by H. S. Pratt in 1925. The latter specimens bear the inclusive registration number P. 173. A few also are described from the Salisbury Bore, 330 feet, from samples in the Tate Museum at the University of Adelaide.

SOME TERTIARY FOSSIL MOLLUSCS

FROM THE

ADELAIDEAN STAGE (PLIOCENE) OF SOUTH AUSTRALIA

By BERNARD C. COTTON, Conchologist, South Australian Museum.

Plates xx–xxii.

INTRODUCTION.

While working out the macrofauna of numerous water bores sunk in the Adelaide Plains by the Mines Department, for agricultural purposes and to provide water for pumping into the mains, a number of interesting molluscs were discovered. A few of these are described here; also some Abattoirs bore specimens selected by Sir Joseph Verco and myself from material donated to the South Australian Museum by H. S. Pratt in 1925. The latter specimens bear the inclusive registration number P. 173. A few also are described from the Salisbury Bore, 330 feet, from samples in the Tate Museum at the University of Adelaide.

Recent examination of material from the uppermost oyster beds at Mannum, Swan Reach and some other places along the River Murray cliffs, proves a similar suite of fossils to be present, with the dominant *Ostrea arenicola* and also *O. sturtiana*. These uppermost beds of the Murray Cliffs are probably exposures of the Adelaidean stage. From deep building excavations in the central city area, samples of the Adelaidean stage have been obtained. A rich bed of this deposit was found in the seepage well at the base of the Bank of New South Wales, King William Street, excavations at about 50 feet. A sample from there was found in the Mines Department. It contains the following typical Adelaidean fossils: *Mimachlamys antiaustralis, Equichlamys consobrinus, Equichlamys subbifrons, Spondylus spondyloides, Ostrea arenicola, Velctuccla subradians, Neodiastoma provisi.*

Samples from the same and other localities are in the South Australian Museum. Apparently this is a similar bed to that mentioned by Tate, 1883, in the Kent Town Bore "Series a" in which he records "oysters and pectens" as dominant. Incidentally, *Equichlamys consobrinus* and *E. subbifrons* both of Tate 1885, seem to be synonymous, *E. consobrinus* having priority, *E. subbrifrons* being probably a juvenile. This Adelaidean deposit of fossils forms the principal porous bed in which the water of the aquifer is contained under the Adelaide Plains.

THE UPPERMOST BEDS OF THE MURRAY.

Species found in the bores and also recorded by Tate from his "Oyster banks of the Upper Murravian" are listed here. Those originally recorded from this bed in the Murray cliffs have the word (type) following the corrected name.

Barbatia crustata Tate (type).
Pinctada crassicardia Tate.
Ostrea arenicola Tate.
?=*Ostrea sturtiana* Tate (type).
Cardita compta Tate.
Venericardia pecten Tate.
Epicodakia affinis Tate (type).
Numella suborbicularis Tate (type).
Coriareus sericea Tate.
Placamen subroboratum Tate.
Antigona dictua Tate (type).
?=*Antigona pernitida* Hooper Woods
Callanaitis paucirugata Tate.
?=*Callanaitis murrayana* Tate. (type).
Notocorbula ephamilla Tate.
Venerupis paupertina Tate.
Plebidonax depressa Tate (type).
Myadora tenuilirata Tate.
Marginella propinqua Tate.

To this list I can now add the following species also found in the uppermost beds of the Murray Cliffs. Many more species may be added when time and opportunity permit a palaeontological survey of the Murray Cliffs to be made and when a deeper study of the Tate Museum, South Australian Museum and Mines Department collections is undertaken.

Neotrigonia trua sp. nov. Recorded as *Trigonia acuticostata* McCoy.
Eucrassatella cf. *camura* Pritchard. Recorded as *Crassatella oblonga* Tenison Woods.
Divalucina entypoma sp. nov. Recorded as *Divaricella quadrisulcata* d'Orbigny.
Zemysia solitaria Hooper Woods. ?=*Diplodonta subquadrata* Tate.
Cleidothaerus adelaidensis sp. nov.
Monia tatei Chapman and Singleton. Recorded as *Placunomia ione* Gray.
Mimachlamys antiaustralis Tate.
Tucetona crama sp. nov. Recorded as *Pectunculus convexus* Tate.

THE UPPERMOST BEDS AT ALDINGA, HALLET COVE, EDITHBURGH, STANSBURY AND THE METROPOLITAN AREA.

The following species found in the bores have been recorded from Aldinga (A), Hallet Cove (H), Metropolitan Area "Oyster and pecten beds" (M), Edithburgh (E), Stansbury (S), Oyster beds, Government House Quarry (G).

Equichlamys consobrinus Tate. A. (type) H.
?=*Equichlamys subbifrons* Tate. G. (type).
?=*Equichlamys palmipes* Tate. E. (type) A.

Mimachlamys antiaustralis Tate. M. (type) A., E., S.
Spondylus spondyloides Tate. A. (type) H., M.
Amusium lucens Tate. A. (type).
Ostrea arenicola Tate. A. (type).
Atrina semicostata Tate. M. (type) A.
Brachyodontes submenkeana Tate. H. (type) A.
Venericardia trigonalis Tate. A. (type).
Epicodakia araea Tate. A. (type).
Epicodakia nuciformis Tate. A. (type).
Epicodakia fabuloides Tate. A. (type).
Wallucina simulans Tate. A. (type).
Kellia planiusculum Tate. A. (type).
[*Tellina lata* Quoy and Gaimard, Recent Indo-Pacific] A.
Anapella variabilis Tate. A. (type).
Myadora corrugata Tate. G.
[*Panopaea orbita* Hutton, New Zealand] A.
Lithodomus brevis Tate. H. (type).
Emozamia anceps Tate. A. (type).
Cymatiella sexcostata Tate. A. (type).
Cominella subfilicea Tate. A. (type) H.
Cominella clelandi Tate. H. (type).
Baryspira orycta Tate. A. (type).
Zemitrella mitrellaeformis Tate. A. (type).
Pervicacia crassa Tate. A. (type).

PELECYPODA.

PRONUCULA HEDLEY.

Pronucula Hedley 1902, Mem. Aust. Mus., 4, 290.

The Tertiary species *P. morundiana* and *P. fenestralis* Tate, belong to this genus judging from the development of the concentric and radial sculpture and the crenulated internal margin of the shell. An examination of the teeth and chondrophore should confirm this.

EUNUCULA Iredale.

Eunucula Iredale 1931, Rec. Aust. Mus., 18, No. 4, 202.

Genotype: *Nucula obliqua* Lamarck 1819. Recent, Southern Tasmania.

Recent: S.A., Vict., N.S.W., Q., W.A. Beach to 100 fathoms.

Fossil: Australia; Miocene. Pliocene. Pleistocene.

Remarks: The Recent European genotype of *Nucula*, *N. nucleus* Linne, differs from recent and fossil Australian *Eunucula* which the author of the genus pointed out has a "notably oblique chondrophore; above which the teeth become much smaller and the angle of opposition of the two rows of teeth is scarcely marked; further, the edge of the European shell is strongly denticulate, whereas ours is smooth." A complex group of Recent, shallow and deep water species belonging to this genus have been described, the localities ranging from New Guinea to Queensland, Victoria, South Australia and Tasmania. Many have been lumped under the familiar name *N. obliqua* Lamarck, a Southern Tasmanian living species.

ARCA NEGATA sp. nov.

Plate xx, figs. 11, 12.

Shell trapeziform, rounded in front, obliquely truncated posteriorly; hinge lines straight; umbones anterior, distant, acute; ventral margin with an almost median byssal gape; a sharp ridge runs from the umbo to the posterior ventral angle; anterior to the angle the sculpture consists of close fine radial ribs abruptly changing to less numerous wider radial ribs on the larger anterior portion. Height 11 mm., length 24 mm. (holotype).

Loc.: Bore 65, 385–395 feet, holotype, Adelaidean.

Remarks: This species, which may grow to twice the size of the holotype, somewhat resembles the Recent *Arca navicularis* Bruguiere 1792 from Amboina, related to *Arca subnavicularis* Iredale 1939 from North Australia. The Pliocene fossil here described as *A. negata* is nearest to *A. pseudonavicularis* Tate 1886 from the Adelaide Bore, Janjukian, but is differently sculptured. The new species is a true *Arca* according to Opinion 189 of the International Commission on Zoological Nomenclature which decided, "Under suspension of the rules:

(i) To set aside all type designations of *Arca* Linnaeus 1758, Syst. Nat. (Ed. 10) 1, 693 (Class Pelecypoda, Order Filibranchia), made prior to the date of this opinion;

and (ii) To designate *Arca noae* Linnaeus 1758, Syst. Nat. (Ed. 10) 1, 693, as the type of *Arca* Linnaeus 1758."

The genus *Navicula* Blainville 1825, introduced for the same genotype, has thus become a direct synonym, as does *Byssoarca* Swainson 1833, *Arca* Gray 1847, *Cibota* Moerch 1853, *Daphne* Poli 1791 (not Mueller 1776) and *Daphnoderma* Poli 1795.

Six Recent Australian species are described from Northern Australia.

Specimens recorded from the Adelaidean as *A. crustata* Tate 1886, described from the "Oyster Beds of the River Murray Cliffs at the North-west Bend" may be a smaller species related to *A. negata*.

BARBATIA EPITHECA sp. nov.

Plate xx, figs. 14, 17.

Shell irregularly subquadrangular, rather inflated, inequilateral; anterior end rounded; posterior side longer than the anterior, obliquely truncate and sharply rounded; ventral margin with a slight median sinuation; surface of valves sculptured with very fine and numerous radials crossed by almost equally developed concentrics; umbones moderately prominent, ligamental area narrow; height 12 mm., length 23 mm.

Loc.: Abattoirs Bore, holotype, Adelaidean.

Remarks: This species is related to the Recent *B. pistachia* Lamarck 1819 from King Island, Bass Strait (type) which is found living in southern Australia. *Barbatia limatella* Tate 1886, another allied species, was described from "Sandy Clays at Blanche Point, Aldinga Bay, and argillaceous glauconitic sands, Adelaide Bore." Tate's figured type is from "Adelaide" or Adelaide Bore, Janjukian, and is different from the Adelaidean species in shape and colour.

ACAR COMA sp. nov.

Plate xx, figs. 25, 26.

Shell subquadrangular, hinge line straight, umbones close, but slightly prominent; sculpture of concentric lamellae frilled radial, flattened ribs; ventral margin gently medially sinuate; anterior margin rounded, posterior angled and obliquely truncate; an obtusely angled ridge runs from the umbo to the posterior ventral angle. Height 10 mm., length 23 mm.

Loc.: Weymouth's Bore, 345–350 feet, Adelaidean.

Remarks: Related to *Barbatia celleporacea* Tate 1886 from Schnapper Point, Victoria (type), but differs in shape and sculpture, being also like the Recent *A. laminata* Angas 1865 from Gulf St. Vincent, S.A.

Other Recent species belonging to that genus are *A. divaricata* Sowerby (genotype), from Annaa Island, *A. reticulata* Gmelin=*A. domingensis* Larmarck, West Indian, *A. plicata* Dillwyn, Red Sea, *A. dubia* Baird, New Caledonia, *A. digna* Iredale, Lord Howe Island, *A. iota* Iredale, Low Island, Queensland, *A. botanica* Hedley 1916, Port Jackson, *A. kerma* Iredale, Kermadec Island.

CUCULLAEA PRAELONGA SINGLETON.

Cucullaea corioensis praelonga Singleton 1932. Proc. Roy Soc., Vic., N.S. 44 (2), 303, pl. 26, fig. 20a, b.

The holotype is from Forsyth's, Grange Burn, near Hamilton, Victoria, Lower Pliocene, Kalimnan. Specimens are common in the Adelaidean, and appear to be this species, rather than *C. corioensis*. Singleton 1932 remarked that *C. praelonga* may grow to over 100 mm. in length. I have seen fragments of the Adelaidean shell suggesting even larger specimens than this. *Cucullaea corioensis* McCoy 1876 from Bird Rock Cliffs, near Spring Creek, Torquay, Janjukian, does not appear to survive beyond the Balcombian. *Cucullaea adelaidensis* Tate 1886 is still another species decribed from the Glauconitic Sands, Adelaide Bore, Aldinga.

FAMILY *GLYCYMERIDAE*.

Chapman and Singleton 1925, Proc. Roy. Soc. Vict., 18–60, pl. 1–4, revised the Tertiary Fossil *Glycymeris*. There are some thirty Recent and twenty Cainozoic species which may now be placed in their proper genera. The genotype of *Glycymeris* Da Costa 1778 is the Recent *Arca glycymeris* Linne, from the coasts of Britain and it is a large, almost smooth but transversely and longitudinally finely striate species ornamented with angular red spots. There is also a *Glycymeris* Schumacher 1817, a synonym of *Saxicava*. *Pectunculus* Lamarck 1799, used by continental authors of the past, is unavailable for this family, there being a previous *Pectunculus* Da Costa 1778 related to *Dosinia*. Australian Tertiary fossils may be grouped as follows:

Veletuceta Iredale 1931. Genotype *Glycymeris flammeus* Reeve.
- *striatularis* (Lamarck) 1819. Recent W.A. (type) Kalimnan, Werrikooian.
- *subradians* (Tate) 1902. Hallett Cove, Adelaidean.
- *halli* (Pritchard) 1903. Grange Burn, Kalimnan.
- *mistio* (Finlay) 1927. Not *intermedea* Broderip 1832.
- =*intermedia* (Pritchard) 1903. Muddy Creek, Upper Beds, Kalimnan.
- *paucicostata* (Pritchard) 1903. Jemmy Point, Kalimnan.
- *pseudaustralis* (Singleton) 1941. Glenelg River, Werrikooian.

Tucetilla Iredale 1939. Genotype *Glycymeris capricornea* Hedley.
- *cainozoica* (Tenison Woods) 1887. Table Cape, Janjukian.
- *maudensis* (Chapman and Singleton) 1925. Maude, Lower Beds, Janjukian.
- *rota* sp. nov. Abattoirs Bore, Adelaidean.

Tucetona Iredale 1931. Genotype, *Pectunculus flabellatus* Tenison Woods.
flabellatus (Tenison Woods) 1878; Recent, N.E. Tas. (type) Werrikooian.
convexa (Tate) 1886. Muddy Creek, Upper Beds, Kalimnan.
crama sp. nov. Abattoirs Bore, Adelaidean.
subtrigonalis (Tate) 1886; Morgan, Janjukian.
decurrens (Chapman and Singleton) 1925. Grange Burn, Kalimnan.
Melaxinaea Iredale 1931. Genotype *Melaxinaea labyrintha* Iredale.
planiuscula (Chapman and Singleton) 1925. Glenelg River, Werrikooian.
Grandaxinaea Iredale 1931. Genotype *Glycymeris magnificans* Iredale.
maccoyi (Johnston) 1800. Table Cape, Janjukian.
ornithoptera (Chapman and Singleton) 1925. Torquay, Janjukian.
gunyoungensis (Chapman and Singleton) 1925. Grice Creek, Balcombian.
lenticularis (Tate) 1886. Adelaide Bore, Janjukian .
granti (Singleton) 1932. Muddy Creek, Lower Beds, Balcombian.

Glycymeris australis var. *gigantea* Chapman 1915, from Vivonne Bay, Kangaroo Island, Werrikooian, belongs to the family *Lucinidae* as pointed out by Singleton, 1941.

TUCETILLA MAYI sp. nov.

Plate xx, figs. 18, 19.

Shell suborbicular, a little ovate and slightly produced at the posterior end; sculpture of fine and numerous radial riblets split as the shell grows into grouped secondary still finer threadlets; umbones subcentral, hinge teeth delicate, about ten on each side. Height 18 mm., diameter 20 mm.

Loc.: S.A. Beachport 100 fathoms (holotype), also 200 fathoms, Tas., Cape Pillar 100 fathoms, 40 fathoms.

Remarks: According to May, 1923, Illust. Index Tas. Shells, pl. 2, fig. 7, this species figured under the name *Glycymeris tenuicostatus* Reeve, from Cape Pillar, 100 fathoms, grows larger, but May's specimens in the South Australian Museum are little larger than the South Australian shells. May gave the depth for Tasmanian shells as "40–100 fathoms, not uncommon." The present series is more ovate and has finer sculpture than the North Queensland *Glycymeris tenuicostatus* Reeve 1843. The hinge teeth are less well developed than in either Reeve's species or in the fossil species described below.

TUCETILLA ROTA sp. nov.

Plate xx, figs. 3, 4.

Shell suborbicular, rather small, somewhat ventricose; sculpture of fine and numerous riblets and between each pair of major riblets secondary still finer

threadlets occur, increasing in number as the shell grows; umbones subcentral, hinge teeth fine, about twelve on either side. Height 19 mm., diameter 20 mm.

Loc.: Abattoirs Bore, holotype, Adelaidean.

The species is related to *T. mayi* rather than to *T. tenuicostata* Reeve, but it is rounder and more delicately sculptured than the Tasmanian species.

TUCETONA CRAMA sp. nov.

Plate xx, figs. 1, 2.

Shell solid, orbicular, slightly transverse, inequilateral; umbones approximate; radially ribbed; radial ribs narrow interspaces deeply furrowed; squamose concentric ornament; ribs numbering twenty-two rather flattened, inner margin of valves strongly crenate; cardinal teeth, about eight on each side. Height 30 mm., length 32 mm.

Loc.: Abattoirs Bore, holotype, Adelaidean.

Remarks: This species has been recorded from the Adelaidean as *Glycymeris convexus* Tate 1886, Muddy Creek, Upper Beds Kalimnan (type). Chapman and Singleton 1925 under *Glycymeris convexa* Tate, write: "Shells from the upper beds of the Adelaide Tertiary Basin as also in the Abattoirs and other bores, show a certain amount of variation from the Muddy Creek, topotypes, the South Australian examples being in general more depressed and with distinctly flattened ribs. The concentric ornament is also more developed as a series of undulose growth lines which cross the quadrately depressed ribs."

Two Recent South Australian species *T. flabellatus* and *T. broadfootae* resemble the present species which has a tendency to the deep radial interstitial furrows of *T. broadfootae*, but it is a much smaller and flatter shell.

PINCTADA CRASSICARDIA (Tate).

Meleagrina crassicardia Tate 1886. Trans. Roy. Soc., S. Aust., 8, 121, pl. 9, figs. 9, 10.

Large fragments of this species are common in the Adelaidean. The Recent *Pinctada carchariarium* Jameson 1901 from Sharks Bay is closely allied and is abundant as a raised beach subfossil at Murat Bay, South Australia. Six Recent species inhabit Northern Australia.

CTENAMUSIUM ATKINSONI (Johnston).

Amusium atkinsoni Johnston 1880. Proc. Roy. Soc. Tas. 29.

The holotype was described from Table Cape and it is distinct from *zitteli* Hutton 1873 "Upper Eocene," Poverty Bay, New Zealand, and the Recent

thetidis Hedley 1902. Specimens were picked out of the Salisbury Bore, 330 feet. Shells of the palaearctic genera *Propeamusium* Gregorio 1884, *Parvamussium* and *Variamussium* are different from the Australian species such as *atkinsoni* which belong to *Ctenamusium* Iredale 1929 and there are two Recent species, the genotype *C. thetidis* Hedley of Eastern and Southern Australia and the deeper water *C. calacon* Iredale 1929, of N.S.W.

OSTREA ARENICOLA Tate.

Ostrea arenicola Tate 1885. Trans. Roy. Soc. S. Aust., 8, 97, pl. 10, fig. 6.

The species was described from the Upper Aldinga series of Aldinga (Adelaidean) and is the common oyster and dominant shell of the Adelaide Bores, being plentiful in the aquifer. It is closely related to the Recent Port Lincoln Oyster *Ostrea sinuata* (=*angasi*) and to the Upper Pliocene, Werrikooian *Ostrea sinuata glenelgensis* Singleton 1941. This species is displayed in the Tate Museum at the University of Adelaide from the Abattoirs Bore as "*Ostrea sp.*" Like most species of *Ostrea*, it is variable and the "extreme variety" of *O. arenicola* mentioned by Tate from the "Upper Murravian" at the North-west Bend is probably the same species. It seems quite likely that *O. sturtiana* Tate from "the upper part of the River Murray Cliffs, from Overland Corner to beyond Blanchetown," is merely a senile form of *O. arenicola*, as its hinge development suggests. The narrow shape may be due to crowded conditions. The Recent *O. sinuata* when growing in clusters frequently becomes elongate and develops a longer ligamental area. Further study would be required to confirm this, but if the theory is correct, *O. sturtiana* has priority.

LOPHA HYOTIDOIDEA (Tate).

Ostrea hyotidoidea Tate 1899. Trans. Roy. Soc. S. Aust., 23, 268.

Tate first identified this fossil species as *Ostrea hyotis* Linne, which is a Recent tropical shell from the Indian Ocean and north Australia. He later renamed the fossil from the Murray River Cliffs, *O. hyotidoidea* Tate 1899. Both this and the Recent shell belong to the peculiar "Coxcomb" oysters classed under the genus *Lopha*. The fossil has been recorded from the Adelaidean, but so far I have not seen it in the bores examined.

NEOTRIGONIA TRUA sp. nov.

Plate xx, fig. 5–6.

Shell trigonal, compressed ribs, twenty eight, narrow set with close, fine lamellae; anterior margin convex, dorsal at first slightly convex, then concave and

later forming an abrupt angle with the convex ventral margin; hinge teeth striations about six on each of the two teeth. The shell is grey in the Adelaidean fossils with a silver-coloured nacre preserved within. Height 25 mm. diameter 26 mm.

Loc.: Abattoirs Bore, holotype, Adelaidean.

Remarks: This species is related to the Recent *N. bednalli* Verco, but it is smaller and has finer lamellae on the radial ribs. It is less like *acuticostata* McCoy 1886 from Beaumaris—(Mordialloc) type locality of the "Cheltenhamian." *Eotrigonia* with its discrepant ornament of the Mesozoic species is represented by the genotype *Eotrigonia semiundulata* Jenkins in the Miocene beneath the Adelaidean of the Adelaide Plains.

CUNA APOREMA sp. nov.

Plate xx, fig. 7–8.

Shell rather thick, subtrigonal, sides slightly convex, umbonal angle rather less than a right angle; prodissoconch minute and indistinct; cardinal and lateral teeth well developed; ventral border widely rounded, smooth, not crenulated or denticulated within or without, no radial sculpture, but there are coarse concentric, irregular incremental imbrications interspersed with microscopic incremental striae. Height 5 mm., diameter 4·25 mm.

Loc.: Bore 41, 405–407 feet, holotype, Adelaidean.

Remarks: This species is plentiful in the Adelaidean. The living species *Cuna solida* Cotton 1931 is somewhat similar in shape, but in no other respect, while the general features, smooth ventral margin and concentric sculpture recall the minute *Cuna cessens* Verco 1908. Of the Tertiary species, *Cuna polita* Tate 1887, from Muddy Creek, Lower Beds, is somewhat similar in shape, but *C. aporema* differs in its coarser sculpture and larger size.

EUCRASSATELLA CAMURA (Pritchard).

Plate xx, figs. 15, 16.

Crassatellites camurus Pritchard 1903. Proc. Roy. Soc. Vict., 15 (2), 96, pl. 14, figs. 5, 9.

The shell found commonly in the Adelaidean is note quite like the Kalimnan species or the Miocene *oblonga* Tenison Woods 1876 from Table Cape. A specimen from the Abattoirs Bore is figured here. Height 45 mm., diameter 70 mm. It will be further studied when a more extensive series is available.

CARDITA COMPTA (Tate).

Mytilicardia compta Tate 1886. Trans. Roy. Soc. S. Aust., 8, 149, pl. 12, fig. 2.

An Adelaidean fossil has been listed from the Abattoirs Bore as *Cardita preissi* Menke 1843, which is a Recent shell from Western Australia, the name being a direct synonym of *Cardita incrassata* Sowerby 1825. Verco 1912 records it from Geraldton and Iredale 1914 from Montebello Island. The Adelaidean shell seems more nearly related to *Cardita compta* Tate, from Muddy Creek, Victoria.

EPICODAKIA SALEBROSA (Hooper Woods).

Codakia salebrosa Hooper Woods 1931. Trans. Roy. Soc. S. Aust., 55, 149, pl. 8, figs. 4, 5.

Specimens of this species are found in the Salisbury Bore 330 feet Adelaidean. The genus belongs to the family Lucinidae of which *Lucina* Lamarck 1799 has for the genotype *Lucina edentula* Linne from Jamaica. *Codakia* Scopoli 1777, genotype *C. orbicularis* Linne from West Africa was once used for the large Aestralian shells, now classed under *Pexocodakia*, genotype *Lucina rugifera* Reeve 1850 from New South Wales. The fossil species is related to *Epicodakia gunnamatta* from New South Wales and belongs to the same genus.

MILTHOIDEA HORA nom. nov.

Dosinia grandis Hooper Woods 1931. Trans. Roy. Soc. S. Aust., 55, 148, pl. 7, figs. 5, 6.

This name, given to a species described from the Abattoirs Bore, is preoccupied by *Dosinia grandis* Nelson 1870, Trans. Conn. Acad. Sci., 2, 201, from the Tertiary of Peru. The new name *Milthoidea hora* is introduced here for this large characteristic species of the Lucinidae.

DIVALUCINA ENTYPOMA sp. nov.

Plate xx, figs. 9, 10.

Orbicular, subinflated, moderately thick, with devaricate sculpture; the circular outline is truncate posteriorly and the umbones are at the angle and middle of the two dorsal margins which form an obtuse angle. Height 20 mm., diameter 20 mm.

Loc.: Abattoirs Bore, holotype, Adelaidean.

Remarks: The name *Divaricella quadrisculata* d'Orbigny 1847, Recent, West Columbia, was introduced into Australian Tertiary Molluscan nomenclature by

Tate 1886, but the fossil species is closely related to the South Australian Recent species *cumingi* Adams and Angas 1867, the genotype of *Divalucina* Iredale 1936, though differing in the fineness of the sculpture. *Divaricella* von Martens 1880, applied to a small Mauritius shell, *D. angulifera*, related to *Divaricella occidua* Cotton and Godfrey 1938 from Western and South Australia, has fine sculpture and notable lateral teeth not present in *Divalucina*. The specimen figured by Tate 1885, Trans. Roy Soc. S. Aust., pl. 12, fig 3, under the name *Lucina dentata* Wood from North West Bend, Oyster Beds, River Murray, is probably *D. cutypoma*, as Tate incorrectly applied this name and *L. eburna*, Recent West Columbia to the fossil described here. Still another name used, but inapplicable, is *Lucina divaricata Linne*, originally described as *Tellina divaricata* Linne from the Mediterranean, but later figured by Reeve as *Lucina divaricata* Linne from "West Indies, Cape York, North Australia; Jukes." *L. divaricata* is the type of the genus *Lucinella* Monterasato 1883 and *dentata* Wood is regarded as a synonym. The genus is readily separated from *Divaricella* or *Divalucina* by the characteristic strongly dentate posterior edge. *Lucinella divaricata* is included in a recent list of British Marine Mollusca as *Divaricella divaricata* Linne, but the British authority, R. Winckworth, puts "*Quaerenda*" before the name and refers to Forbes and Hanley's "A History of British Mollusca and their Shells" and to Jeffrey's "British Conchology," for the record.

CLEIDOTHAERUS ADELAIDENSIS sp. nov.

Plate xx, figs. 23, 24.

Shell rather solid, inequivalve, inequilateral; right valve deep and acutely keeled; attached by the anterior side which in the holotype is concave and bears the impression of the distinctive sculpture of *Proxichione cognata*; umbo anterior, subspiral; dorsal and posterior margin convex, anterior margin almost straight; sculpture of dense lamellae striae; interior nacreous; hinge resilifer subumbonal, shallow; adductor scars slightly unequal. Height 53 mm., diameter 55 mm.

Loc.: K. R. Weymouth's Bore, 450 feet, holotype, Adelaidean. Mines department material.

Remarks: The species is closely related to the Recent *Cleidothaerus albidus* Lamarck 1819 originally described from Tasmania and common in Southern Australia. The fossil species is thinner, has smaller adductor mussel impressions and less developed hinge features. The holotype is a right valve and I have not yet seen a left valve.

A related species was described as *Chamostrea crassa* Tate 1884 from Table Cape, Tasmania, Janjukian. Tate 1886 mentions a specimen from Muddy Creek,

Victoria, under the name *Chamostrea albida* Lamarck, Recent, Tasmania (type), the Southern Australian living species.

MYADORA ALEA sp. nov.

Plate xx, figs. 20, 21, 22.

Shell ovate, solid, anterior rounded, posterior truncate; right valve convex, overlapping the left all round; concentrically sculptured with about thirty slightly irregular ribs about half the width of the interspaces; a ridge runs from the umbo to the postero-ventral margin, becoming less marked towards the margin; left valve flat, less strongly sculptured and smaller. Height 15 mm.; diameter 19 mm.

Loc.: Salisbury Bore, 330 feet, holotype, Adelaidean, Tate Museum.

Remarks: Somewhat like the Recent *M. pervalida* Cotton 1931 from South Australia, but less strongly sculptured, fewer concentric ribs and less tapered posteriorly and smaller. *Myadora ovata* Reeve from the Philippines is differently sculptured.

GASTROPODA.

SOPHISMALEPAS ACRA sp. nov.

Plate xx, figs. 4, 5.

Shell thin, alongate-ovate, depressed; sides a little convex converging towards the anterior end, so giving the shell a tapered effect; anterior sharply rounded, posterior more widely rounded; orifice almost central, large, one-quarter the length of the shell, narrowly oval; sculpture of numerous fine radials, threads crossed by slightly weaker concentric threads with occasional spiral accremental lamellae; interior smooth, margin of shell flattened, internal margin of orifice having a narrow calloused border. Height 3 mm., diameter 14 mm. and 9 mm.

Loc.: Salisbury Bore, 330 feet, holotype, Adelaidean, Tate Museum.

Remarks: This is a more delicate shell than the Recent *S. nigrita* Sowerby 1834, described from South Tasmania, and it is quite different in shape.

TUGALIA NOTA sp. nov.

Plate xxi, figs. 11, 12.

Shell elongate ovate, elevated; protoconch sharp, at the posterior third; base arched, margin of shell crenulated within; front extremity sinuate, sculpture of numerous, fine radial riblets crossed by equally developed concentric riblets, the whole giving a close and regular fenestrate pattern; interior smooth with a groove

corresponding with the sinus running from the anterior margin to the apex. Height 5 mm., diameters 19 mm. and 11 mm.

Loc.: Abattoirs Bore, holotype, Adelaidean.

Remarks: This species is quite distinct from the Recent *T. cicatricosa* Adams 1851 originally described from South Australia. The fossil is an elevated shell without the cicatrix at the top and more like the large *T. parmaphoidea* Quoy and Garmand 1824, Recent, N.S.W. The only other *Tugalia* described from the Adelaidean is *T. infortunatum* Ludbrook, a minute species.

GENA INCOLA sp. nov.

Plate xxi, figs. 13, 14.

Shell elongate, subspiral ear-shaped, rather narrow, depressed; smooth except for accremental growth striae and numerous microscopical spirals; spire flattened, nearly hidden; aperture very large; columella margin concave, simple, a little reflected; outer lip convex, simple and thin. Height 3 mm., diameters 10 mm. and 16 mm.

Loc.: Salisbury Bore, 330 feet, holotype, Adelaidean, Tate Museum.

Remarks: Smaller and differently shaped from either the Recent *G. auricula* Lamarck 1816 of Southern Australia or *G. impertusa* Burrows 1815=*G. strigosa* Adams 1851 of New South Wales or *G. nigra* Quoy and Gainard 1834, of Queensland.

NINA ADELAIDENSIS sp. nov.

Plate xxi, figs. 17, 18.

Shell rather delicate, pyramidal; high and acutely conical; deeply umbilicated; whorls sharply angled; the angle set with comparatively produced, sharp, hollow spines; below the spinose angle of the body-whorl is a prominent nodulose spiral rib; the remaining sculpture consists of a few spaces, narrow, finely nodulose spirals; aperture round, columella simple. Height 16 mm., diameter 12 mm., diameter including last spine on body-whorl 15 mm.

Loc.: Salisbury Bore, 350 feet, holotype Adelaidean, Tate Museum.

Remarks: This remarkable species may belong to the monotypic genus *Nina* Gray 1850, the genotype of which is the *N. cumingi* Philippi from the Philippines and also taken in Queensland, "Caloundra" according to specimens in the South Australian Museum and also in Western Australia. The Tertiary fossil here described is a more delicate shell with a taller spire and wide umbilicus.

LATIAXIS DISSITUS sp. nov.

Plate xxi, figs. 9, 10.

Shell trigonal, spire depressed below the upper part of the body whorl; body whorl rather sharply roundly angulate at the top, the angle forming an obtuse keel set with a single row of large nodules increasing in size with the growth of the shell; sculpture of an unusual pattern of close wrinkled spirals; aperture rather small, narrowly ovate; canal long, narrow; umbilicus wide and deep, the outer margin weakly imbricate; whorls close, but in the unique specimen the body whorl near the aperture begins to show the first stage of separation from the spire whorls. Height 45 mm., diameter 39 mm.

Loc.: Abattoirs Bore, holotype, Adelaidean.

Remarks: The specimen, which is not quite adult, would probably measure say, 50 to 60 mm., in height when fully grown. Compared with the Recent Japanese genotype *L. mawae*, the present species is heavier, less strongly constructed in the middle, while the sculpture is peculiar and the spire of different formation. It bears a resemblance to some larger species of *Coralliophila*.

NOTOTEREBRA gen. nov.

Genotype: *Terebra albida* Gray 1834. Recent, Victoria.

Shell ivory white, seldom brownish white, sometime with a row of small round subsutural brown spots; shell rather wide, whorls flat, suture subimpressed, with a depressed subsutural band scarcely visible in the earlier whorls, but becoming very marked in the later ones; whorls smooth, except for sinuous, oblique accremental striae which are sometimes, gathered into groups so as to form obsolete, very flat, low angular riblets, most valid just below the suture; protoconch of one-and-a-half whorls, slightly swollen, smooth and round.

Recent: Victoria, South Australia, Tasmania.

Fossil: Pliocene and Miocene of Australia.

Remarks: Species belonging to this genus are the Tertiary fossils, *T. simplex* Tenison Woods and *T. angulosa* Tate. The former is said to retain a suggestion of the colour spots sometimes seen in Recent specimens of *T. albida*.

UMBILIA CERA sp. nov.

Plate xxi, figs. 1, 2, 3.

Shell of small size for the genus, ovate; dorsum elevated; highest near to the posterior end, then convex to the anterior end; spire sunken into an umbilicus; anterior and posterior canal comparatively short, each slightly turned to the left;

aperture rather wide, well turned to the left posteriorly; outer lip broad with twenty-six teeth; columella side of aperture with twenty-two well-developed teeth. Height 55 mm., diameter 37 mm. and 27 mm.

Loc.: Abattoirs Bore, 320–410 feet, holotype, Adelaidean.

Remarks: The species is somewhat like the recent *U. beddomei* but quite distinct in the apertural features and in shape. The nearest fossil relative is probably *U. tatei* Cossman or *U. amygdalina* Tate 1890, from a "Well sinking in the Murray Desert," "Cheltenhamian." The present species is shorter, wider and higher and has more strongly developed teeth.

NOTOCYPRAEA ERYMA sp. nov.

Plate xxi, figs. 6, 7, 8.

Shell small, smooth and polished, pyriform; anterior extremity a little produced; aperture narrow, columella teeth fine, numerous short, not produced across the base; outer lip produced posteriorly in a characteristic curve, teeth fine, short, numerous; not umbilicate, spire not elevated, fossula moderately concave. Height 21 mm., diameter 13 mm. and 12 mm.

Loc.: Abattoirs Bore 320–410 feet, holotype, Adelaidean.

Remarks: The Recent *N. piperita* is the nearest described species. The present species is smaller, with wider spaced teeth and slightly more produced.

UBER SUBJUGUM sp. nov.

Plate xxi, figs. 15, 16.

Shell large, thick, smooth, spire small, only slightly visible above the body whorl; aperture semicircular; columella callus thick and spreading, filling the posterior part of the aperture; widely and thickly spreading over the body whorl, almost covering the umbilicus; microscopic sculpture of spirals and normal growth striae. Height 30 mm., diameter 27 mm.

Loc.: Abattoirs Bore, holotype, Adelaidean.

Remarks: This species was recorded by Tate 1893 as *Natica gibbosa* Hutton from a "locality not actually known, but reported as a 'well-sinking in the Murray Desert.' "

Marwick, 1924, writes that "The disposition of the apertural callus is not the same as in the New Zealand species for it is much wider over the umbilicus than on the parietal wall, where it is relatively narrow." The length of the spire is rather variable in Adelaidean specimens. The correct name for the New Zealand species is *Uber huttoni* (von Ihering) 1907, the type being from Broken River, Trelissick Basin. *Polinices gibbosus* Hutton 1915 is a synonym.

CALLITRIPHORA gen. nov.

Genotype: Triforis wilkinsoni Tenison Woods 1879.

Shell elongate, pyramidal, turretted, thick, small, polished, with twelve sloping convex whorls, girdled with four lines of granules; suture slightly canaliculate; protoconch three whorls; smooth and rounded; aperture quadrate, base flattened, with one groove and radiately striate; canal short.

Distribution: Miocene Pliocene.

Remarks: The holotype specimen of *C. wilkinsoni* comes from Muddy Creek (Lower Bed). The shell is more turretted than Recent Australian species and the protoconch is unique in having three smooth whorls. The fossil occurs in the Adelaidean.

COTTONIA HANNAFORDI (McCoy).

Voluta hannafordi McCoy. Prod. Pal. Vict., Dec. 1, 23, pl. 6, fig. 1.

This species originally described from the Lower Beds of Muddy Creek, was found in the Miocene below the Adelaidean in some bores. Other species belonging to the genus are the Tertiary *C. validicostata* Tate= *C. alticostata* Tate, *C. stephensi* Johnson and *C. heptagonalis* Tate. Recent species are *C. dannevigi* Verco (genotype) and *C. nodiplicata* Cox. A closely-allied volute is the Recent *Mamillana mamilla* Gray or False Melon Shell. These remarks are made here because the genus *Livonia*, strictly confined to a West Atlantic area, has been used in connection with some of those Australian shells, with which it has relation whatever. *Livonia* Gray 1858, is a synonym of *Aurina* H. and A. Adams 1853, having the same genotype *Voluta dubia* Broderip 1928, a species of doubtful standing. Maxwell Smith 1942, designated *Aurina dohrni dohrni* Sowerby of Florida, as genotype. Other synonyms of *Aurina* are *Maculopeplum* Dall 1906, and *Volutifusus* Conrad 1862, none of which have any similarity with the Australian Recent and Tertiary species which belong to *Cottonia*.

NOTOVOLUTA TATEANA (Johnston).

Voluta tateana Johnston 1879. Proc. Roy. Soc. Tas., 37.

This Table Cape fossil, or one related to it, occurs in the Adelaidean in the Salisbury Bore 330 feet, and the Abattoirs Bore. The species belongs to *Notovoluta* Cotton 1946, genotype *Voluta kreuslerae* Angas, and other Recent species belonging to the genus are *veronis* Cotton, *perplicata* Hedley. Tertiary fossil species are *U. cathedralis* Tate, *U. pagodoides* Tate and *tabulata* Tate.

EXPLANATION OF PLATES.

Plate xx.

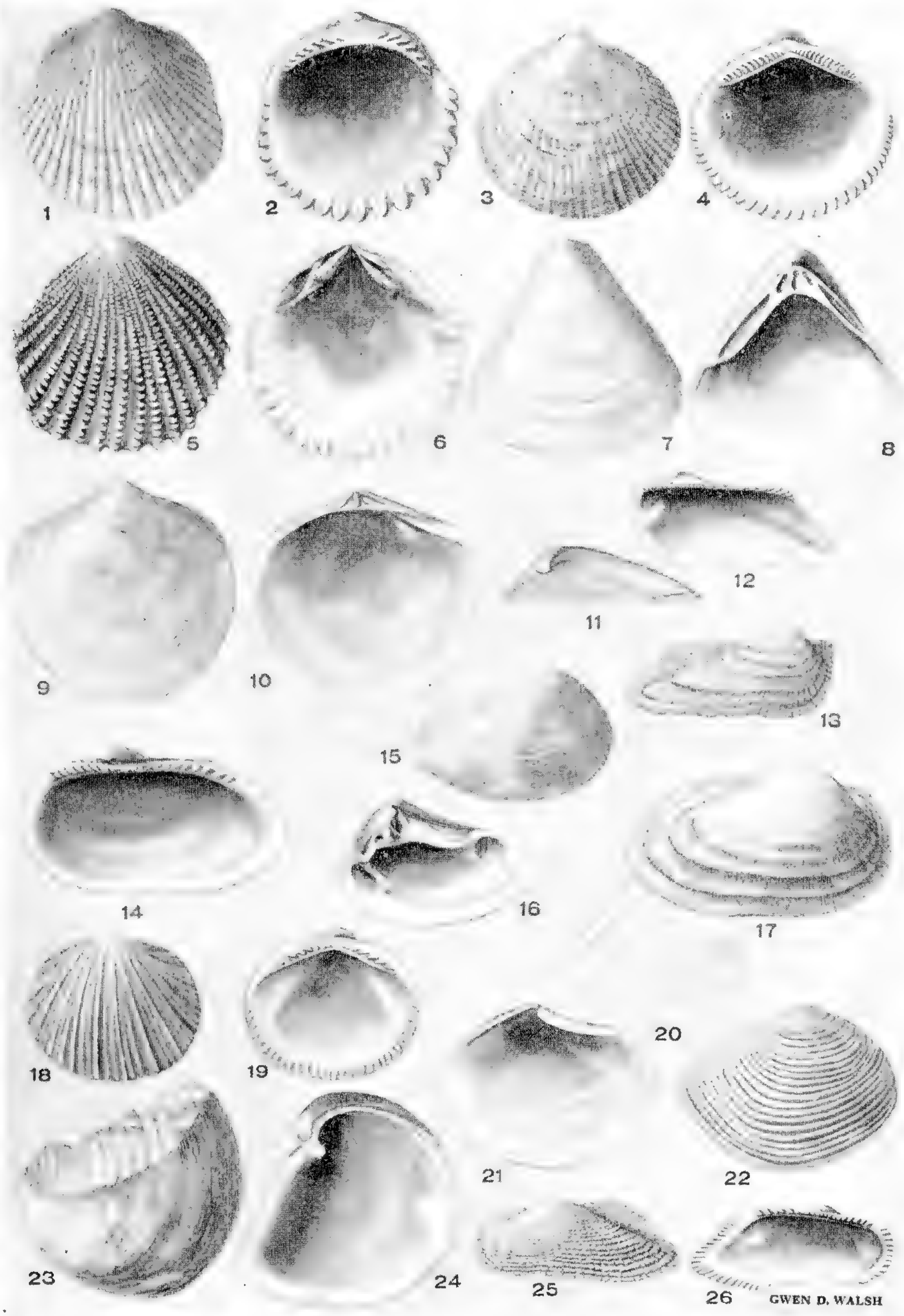
Fig. 1. *Tucetona crama* sp. nov., exterior × 1·2.
Fig. 2. *Tucetona crama* sp. nov., interior × 1·2.
Fig. 3. *Tucetilla rota* sp. nov., exterior × 1·4.
Fig. 4. *Tucetilla rota* sp. nov., interior × 1·4.
Fig. 5. *Neotrigonia trua* sp. nov., exterior × 1·2.
Fig. 6. *Neotrigonia trua* sp. nov., interior × 1·2.
Fig. 7. *Cuna aporema* sp. nov., exterior × 6·3.
Fig. 8. *Cuna aporema* sp. nov., interior × 6·3.
Fig. 9. *Divalucina entypoma* sp. nov., exterior × 1·7.
Fig. 10. *Divalucina entypoma* sp. nov., interior × 1·7.
Fig. 11. *Arca negata* sp. nov., dorsum × 1·2.
Fig. 12. *Arca negata* sp. nov., interior × 1·2.
Fig. 13. *Arca negata* sp. nov., exterior × 1·2.
Fig. 14. *Barbatia epitheca* sp. nov., interior × 1·7.
Fig. 15. *Eucrassatella camura* Pritchard. exterior × 0·4.
Fig. 16. *Eucrassatella camura* Pritchard, interior × 0·4.
Fig. 17. *Barbatia epitheca* sp. nov., exterior × 1·7.
Fig. 18. *Tucetilla mayi* sp. nov., exterior × 1·4.
Fig. 19. *Tucetilla mayi* sp. nov., interior × 1·4.
Fig. 20. *Myadora alea* sp. nov., left valve × 1·7.
Fig. 21. *Myadora alea* sp. nov., right valve interior, holotype × 1·7.
Fig. 22. *Myadora alea* sp. nov., right valve, exterior, holotype × 1·7.
Fig. 23. *Cleidothaerus adelaidensis* sp. nov., exterior × 0·4.
Fig. 24. *Cleidothaerus adelaidensis* sp. nov., interior × 0·4.
Fig. 25. *Acar coma* sp. nov., exterior × 1·2.
Fig. 26. *Acar coma* sp. nov. interior × 1·2.

Plate xxi.

Fig. 1. *Umbilia cera* sp. nov., dorsum × 0·9.
Fig. 2. *Umbilia cera* sp. nov., ventrum × 0·9.
Fig. 3. *Umbilia cera* sp. nov., lateral view × 0·9.
Fig. 4. *Sophismalepas* acra sp. nov., dorsum × 2·3.
Fig. 5. *Sophismalepas acra* sp. nov., ventrum × 2·2.
Fig. 6. *Notocypraea eryma* sp. nov., dorsum × 1·4.
Fig. 7. *Notocypraea cryma* sp. nov., ventrum × 1·4.
Fig. 8. *Notocypraea cryma* sp. nov., lateral view × 1·4.
Fig. 9. *Latiaxis dissitus* sp. nov., ventrum × 0·9.
Fig. 10. *Latiaxis dissitus* sp. nov., dorsum × 0·9.
Fig. 11. *Tugalia nota* sp. nov., dorsum × 1·8.
Fig. 12. *Tugalia nota* sp. nov., ventrum × 1·8.
Fig. 13. *Gena incola* sp. nov., dorsum × 3·2.
Fig. 14. *Gena incola* sp. nov., ventrum × 3·2.
Fig. 15. *Uber subjubum* sp. nov. dorsum × 0·9.
Fig. 16. *Uber subjugum* sp. nov., ventrum × 0·9.
Fig. 17. *Nina adelaidensis* sp. nov., ventrum × 1·8.
Fig. 18. *Nina adelaidensis* sp. nov., dorsum × 1·8.

Plate xxii.

Fig. 1. Sample of Adelaidean Pliocene material from 50 feet beneath the surface in the Bank of New South Wales Building excavations.
Fig. 2. Another view of the Adelaidean material shown above.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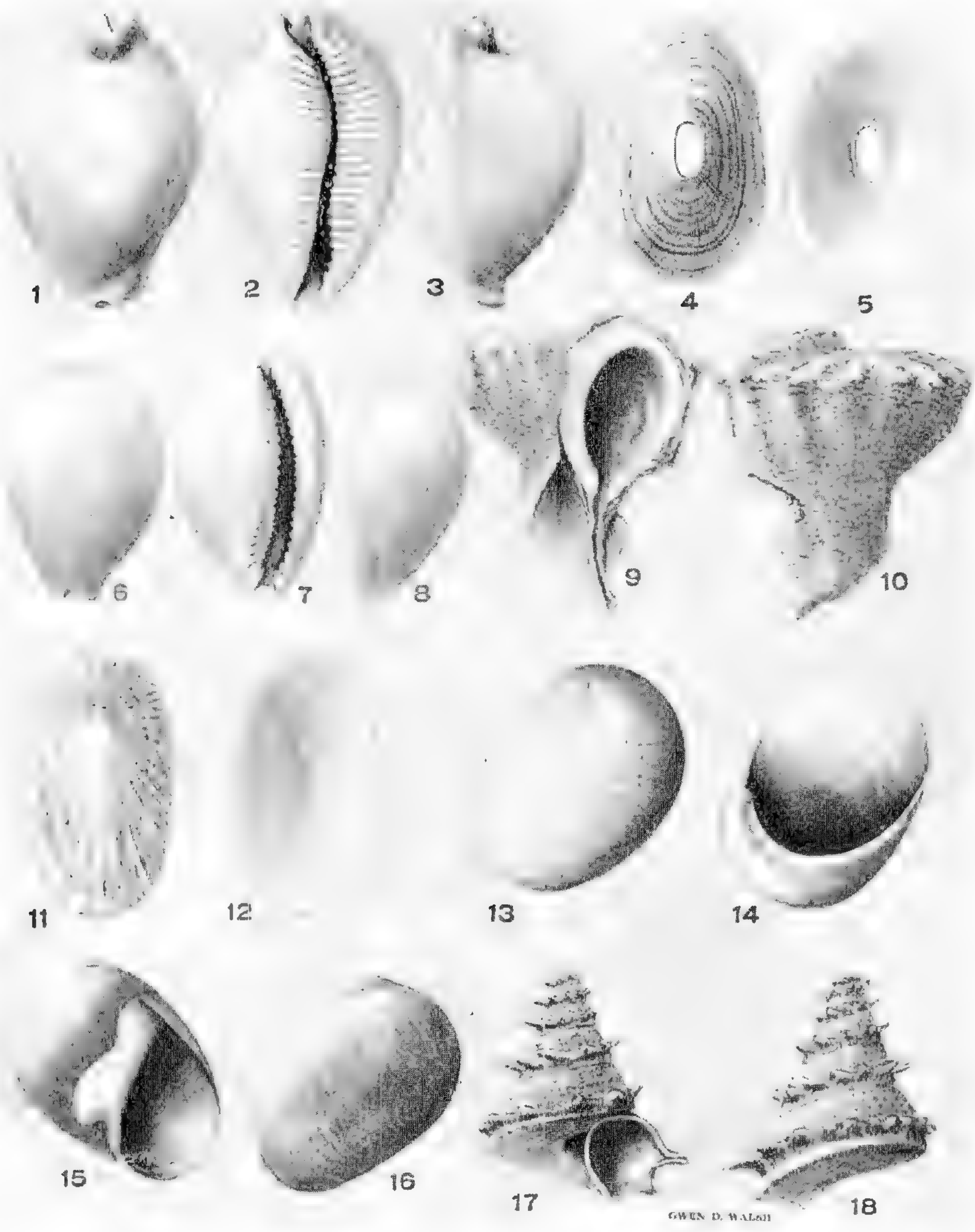
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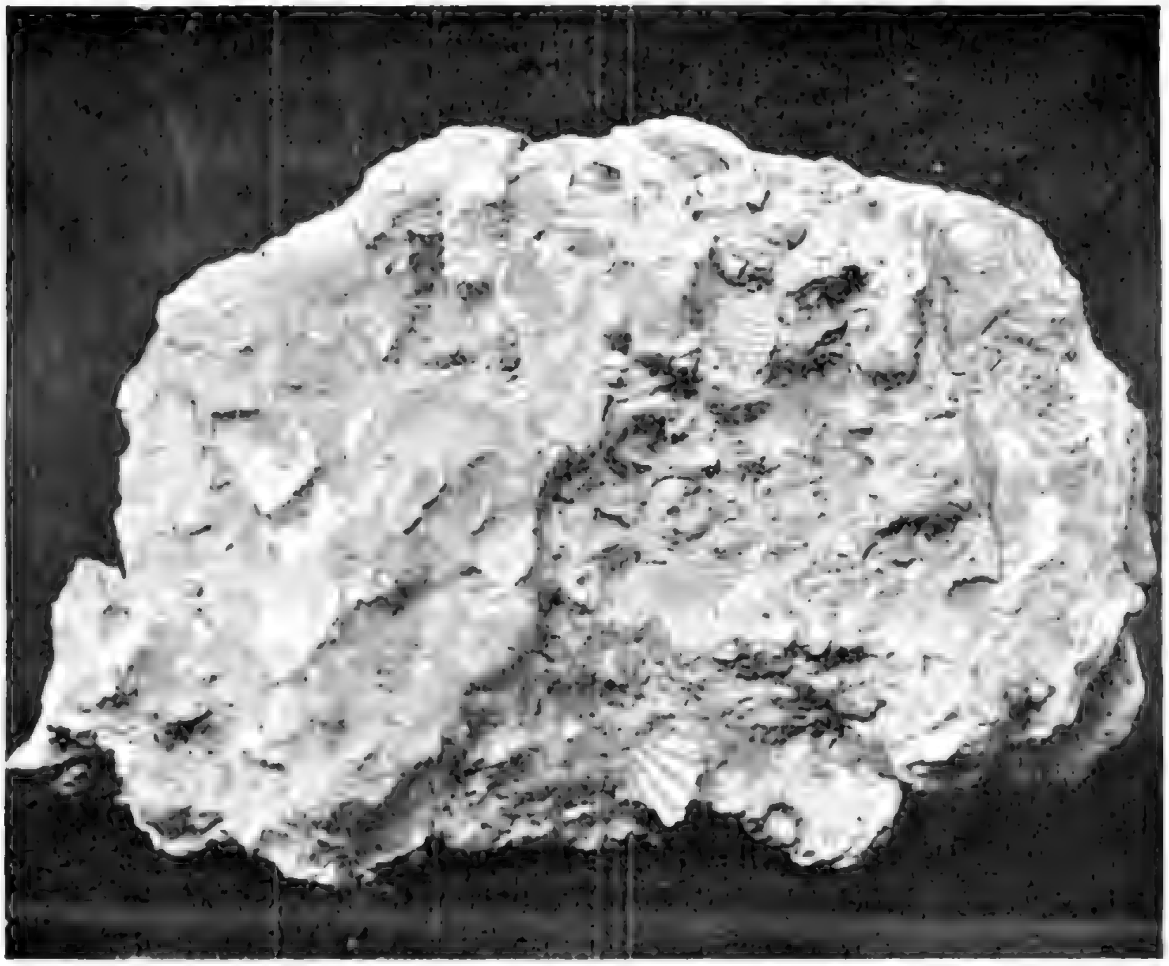

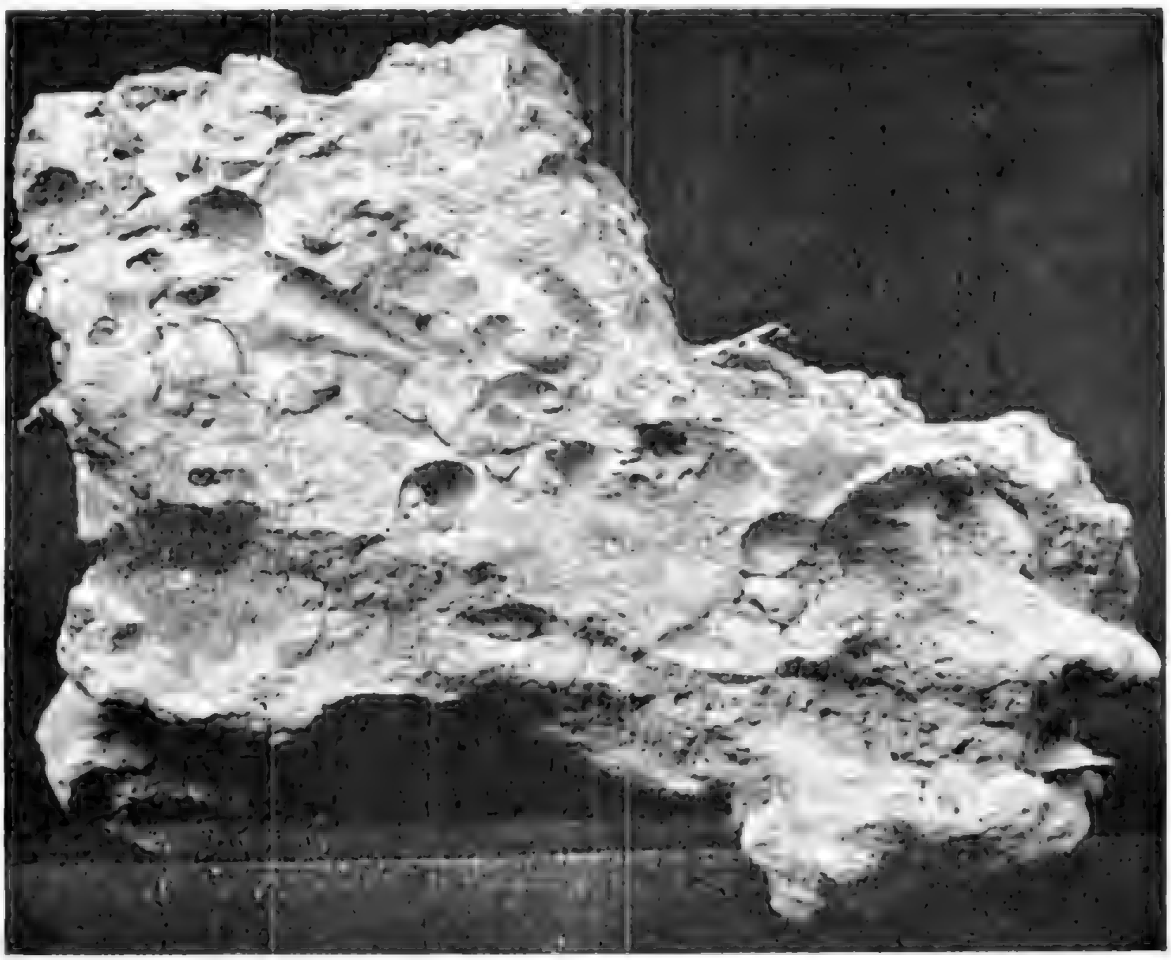

THE VALIDITY OF GALAXIAS KAYI RAMSAY AND OGILBY

BY G. STOKELL, CANTERBURY, NEW ZEALAND

Summary

In 1886 Ramsay and Ogilby described a species of Galaxias from Fifth Creek, South Australia, under the name of kayi, but when Regan revised the Galaxiidae in 1905 he identified this fish with olidus which Gunther (1866, p. 209) based on a single specimen, the locality being given as ? Queensland. Several points of disagreement between the descriptions of G. olidus and G. kayi seemed to lay this identification open to question, and certain circumstances noted in the course of an investigation of the New Zealand Galaxias suggested the possibility of G. olidus being a New Zealand species. In order to clarify the position the writer applied to Dr. Ethelwynn Trewavas of the British Museum who very kindly made an X-ray examination of the type for the purpose of determining the number of vertebrae.

THE VALIDITY OF *GALAXIAS KAYI* RAMSAY AND OGILBY

BY G. STOKELL, CANTERBURY, NEW ZEALAND.

IN 1886 Ramsay and Ogilby described a species of *Galaxias* from Fifth Creek, South Australia, under the name of *kayi*, but when Regan revised the Galaxiidae in 1905 he identified this fish with *olidus* which Gunther (1866, p. 209) based on a single specimen, the locality being given as ? Queensland. Several points of disagreement between the descriptions of *G. olidus* and *G. kayi* seemed to lay this identification open to question, and certain circumstances noted in the course of an investigation of the New Zealand *Galaxias* suggested the possibility of *G. olidus* being a New Zealand species. In order to clarify the position the writer applied to Dr. Ethelwynn Trewavas of the British Museum who very kindly made an X-ray examination of the type for the purpose of determining the number of vertebrae. The result shows that the type of *G. olidus* is a deformed specimen with the vertebrae fused in several places. Evidence of about 50 vertebrae can be discerned, but no reliance can be placed on the count as it has been found in deformities of this nature occurring in known species that several vertebrae may be entirely unaccounted for. Dr. Trewavas states that the type is incomplete and that in the jar with it there is a headless specimen in which, however, the vertebral column is intact. This specimen has 57 vertebrae. An examination of the X-ray photographs (which are deposited in the South Australian Museum) does not enable the present writer to determine if these two specimens are specifically identical, but reveals nothing inconsistent with their being so. If their specific unity is assumed, it is necessary to separate *G. olidus* and the form described by Ramsay and Ogilby on account of the number of vertebrae. Three specimens of this South Australian form which were made available through the kindness of Mr. H. M. Hale, Director of the South Australian Museum, have 51, 51, and 52 vertebrae (without hypural). Ramsay and Ogilby record 53 in the original description. A range from 51 (the minimum in *G. kayi*) to 57 (the number in the headless specimen) is greater than has been observed in any *Galaxias* and cannot be accepted as occurring in a single species. On the other hand, if the type of *G. olidus* is regarded as distinct from the headless specimen associated with it, the sole representative of this species is a single, deformed and incomplete specimen of uncertain locality with which it is impossble to identify any fish. It is therefore necessary to reinstate the name *G. kayi* for the South Australian fish, as it appears to be the first to have been regularly applied. Other species recorded from the locality are *G. schomburgkii* Peters (1868), *G. rostratus* Klunzinger (1872) and *G. nigothoruk* Lucas (1892), the original descriptions of

which are not available. Regan's account of these species is poor and suggests that he had no personal acquaintance with them, but the length of the pectoral fin of *G. schomburgkii*, which he records as extending more than half of the distance to the ventral, seems sufficient to separate this species from the present form, in which the ratio is ·41–·42. In *G. rostratus* the anal fin is said to originate a little behind the origin of the dorsal, while in *G. kayi* the anal origin is beneath the 8th–10th dorsal ray. The species *G. nigothoruk* needs no consideration as it postdates *G. kayi*. An enquiry into the validity of these species is desirable but would require to be carried out in the locality concerned. There are indications that at least some of them are based on single specimens.

The status of *G. olidus* depends on what view is taken of the headless specimen associated with the deformed type. If the headless specimen is accepted as practically a co-type it may be possible to identify the species with some existing form, but otherwise the name *olidus* must be regarded as invalid. The solution of this problem may be assisted by access to the X-ray photographs of the two specimens.

A description of the present specimens of *kayi* is given below.

GALAXIAS KAYI Ramsay and Ogilby.

Galaxias kayi Ramsay and Ogilby, Proc. Linn. Soc., N.S. Wales, v. i (2), 1886, p. 6.

Galaxias olidus Regan, Proc. Zool. Soc., ii, 1905, p. 381. B. 7–7. D. iii–iv, 7–9. A. iv–vi, 8–10, V. 7–7. Vertebrae (without hypural 51–52).

Jaws about equal, without or with slightly developed lateral canines, entopterygoidal teeth strong, 7 on each bone, gill rakers short, 8–10 on lower limb of anterior gill arch, pyloric caeca short but definite. Maxillary scarcely extending to middle of eye, head 5·07–5·28 in standard length, dorsal inserted at ·68–·73 of standard length, least depth of tail ·55–·58 of the distance from rear of dorsal to base of caudal, caudal emarginate with tips of lobes rounded. Pectoral extending ·41–·42 of the distance from its axil to the ventral, ventral inserted at ·51–·54 of the standard length, extending ·51–·53 of the distance from its root to the anal, anal originating beneath 8th–10th dorsal ray (all counted), branched rays of anal subdivided into 4. Maximum total length observed 79 mm.

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INDEX TO GENERA AND SPECIES

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